GEOMORPHIC STUDY OF THE LOWER SASURKHADERI RIVER BASIN

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FOR THE
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UNDER THE SUPERVISION OF
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This is to certify that **Smt. Mukta Raje** has been doing her research work under my supervision on the topic **"GEOMORPHIC STUDY OF THE LOWER SASURKHADERI RIVER BASIN"** in Geography (Faculty of Arts), and that she has put in the required attendance at this University. The present thesis embodies the result of her careful and Consistent investigation into the subject of her research, and it is her own original work.

I hereby forward it for evaluation by a panel of examiners

Alok Dubey
5/1/2002

(Dr. Alok Dubey)
Supervisor

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INTRODUCTION

The present study is concerned with the geomorphic analysis and its applied aspects of the basin of lower part of Sasurkhaderi river, a tributary of river Yamuna. Geomorphology is concerned with the study of land form, its structure and processes. Thus in geomorphology there are three aspects, viz., form, structure and processes. The form cannot be understood without knowledge of the structure, which has fashioned it. The analysis of structure can provide considerable information about the processes and chronology of events, which occurred in the past. Process is the manner of acting or happening. In other words it connotes the operation and procedure of action and its reaction during a period of time. Geomorphology is the science that studies the analysis of various forms of earth's surface, their origin, historical evolution the processes of their formation and transformation with reference to passage of time. "Geomorphology studies various relief features of lithosphere" (Singh S.). Geomorphology developed from physiography. The word physiography is a wider term which includes the study of lithosphere, atmosphere, hydrosphere but geomorphology is used only for lithosphere. Though geomorphology is an inseparable part of geography yet its foundation is embeded in geology. According to Thorn bury "geomorphology is primarily geology". Geomorphology may be described as the science that lies in between geology and

geography and it studies the geometric form of the earth's surface produced by various regular and hazardous morphodynamic processes during the passage of time. Structure and composition of rocks play a vital role in the formation of land forms. A study of geology is essential for understanding the nature of land forms. According to Strahler the science of geomorphology treats the origin and systematic development of all types of land forms and is a major part of physical geography.

The highest development of the science of geomorphology was achieved by the end of nineteenth century and first two decades of the twentieth century. The modern age in geomorphology began with the advent of new geomorphic concepts in Europe and America during 19th century. During this period the cyclic development of land forms was propounded for which credit goes to W. M. Davis. The concept of geographical cycle propounded by Davis W. M. dominated the geomorphological researches and studies through out the world. The main purpose of the concept was systematic description and genetic classification of land forms. In Britain geomorphologists maintained their separate identity and a different school of geomorphology came into existence which emphasised chronological study of development of land forms. This is known by the name of denudation chronology based on the concept of polympsest (re written hand script)- Singh S. The concept of Davis was vehemently criticized by critics headed by

Penk W. According to Penk land forms are the ratio of the rate of upliftment and rate of erosion. The development of land forms is not dependent on time but is independent of time. Subsequently time dependent cycle theory was replaced by time independent theory. This new theory was dynamic equilibrium theory which was propounded by Hack J. T. and Choley R. J. and others According to this theory land forms are treated as open system which acquires steadiness and equilibrium by continuous input of energy and materials and movement of materials. Continuous criticism of Davisian model of geomorphological cycle resulted in a number of other concepts by scholars, for example, geomorphic system of king (1953, 1962, 1963 and 1967); general land form equation model of Peltier (1957); unequal activity model of Crick may (1959); episodic erosion model of Schumm S. A.; composite model of Polinquist R. C. (1975); tectono-geomorphic model of Morisawa M. (1975). Thus with the passage of time the original methods and approaches, conceptual forms and main points of study of land forms in geomorphology were radically changed. Thus quantitative instead of descriptive geomorphology and deductive instead of inductive methods in the analysis of land form were begun to be emphasized, giving rise to process geomorphology, applied geomorphology etc. Micro instead of macro spatial and temporal study was emphasized.

The utility of the study of the subject is to determine and provide solution to the problems arising as a result of man's action and the resultant reaction of the natural forces on the envirorment. In this way geomorphology has great importance because this science studies the origin and evolution of forms of earth's surface which provide basis for human activities. The geomorphic knowledge derived from researches and techniques developed there by have proved useful to assess, value and utilise the natural resources for the social and economic development for human life. Preventive measures aganist the natural hazards and disasters have also become possible. The study of soil formation, deposition and their nutritive value to vegetation and crops along with measures to cheek erosion and reclaim bad lands for agriculture and other uses is very important.

These are the applied aspects of geomorphology. In the words of Arthur N. Strahler "the topographic features, or land forms, of the earth's surface are of prime concern to man because they influence the placement of his agricultural lands, his cities and his lines of communication".

Important researches have been carried out in the fields of impact and control of the characteristics of the land forms on land use pattern and agriculture with reference to use of geomorphic techniques. For example, K. S. Bhatia and H. P. Chowdhari (1977) have presented their work erosion resulting from run off of rivers on

the hilly slopes of U.P. fluvial processes and their effect on agriculture, Anita Kar and Amal Kar (1981) have worked on significance of geomorphology in agricultural planning, Surendra Singh (1997) has worked on the geomorphic effects on land use in the planning of deserts in Rajasthan. B. L. Sharma (1982) has worked on geomorphic effect on agricultural taxonomy. Savindra Singh and Nira Rastogi (1992) have presented their work on the form of plateau region of Eastern Rinwa and agricultural region alisation.

Attempt has been made in the present study to define a methodology of integrated approach for the regional development of the basin of the lower portion of the Sasurkhaderi river. The study has been attempted at two levels; firstly, the entire region under study has been divided into three hundred and one grids, each of which is treated as a basic unit for the first phase of study to assess and analyse the present variables – drainage (its density, texture and stream frequency) and relief (average slope, relative relief and dissection index); secondly, twenty seven sample villages have been selected on the basis of physio pedological aspects on the one hand and their economic back ground on the other which form the main base for the analysis of the region.

The purpose of selection of the lower Sasurkhaderi river basin is to present a detailed geomorphic study of this lower river basin which is a part of Ganga Yamuna Doab in the vast northern plain. Its

form has been arrived at on the basis of the maps of Survey of India. Such a method has proved helpful in plotting the water shed of the study region with reasonable accuracy. Relationship studied in the study region can well be applied to other similar areas or problems.

In the present study various statistical techniques have been adopted to analyse land forms in the study region. The specific objectives of the study are:

(1) The analytical description and critical interpretation of macro, meso and micro morphological features;

(2) Fluvial processes, riverine environment and management of geomorphic environment;

(3) Study of hydrology through the analysis of surface and ground water in the study region;

(4) The properties of soil and its classification;

(5) Impact of geomaterial, related processes and land forms on agricultural and land use patterns.

The area under study, the lower portion of Sasurkhaderi river basin, lies in the Kaushambi district which before April 1997 formed part of the Allahabad district. The basin has a catchments area of about 30,100 hectares and is located between 25° 26’ 40’’ and 25 ° 32’ north parallels of latitude and between 80° 25’ and 81° 49’ east meridians of longitude. The entire study region consists of parts of

each of the six blocks, viz., Sirathu, Manjhanpur, Kaushambi, Muratganj, Newada and Chail. The present study has been divided into six chapters concerning with geomorphic processes, associated morphological features relating to soil and its influence of land use pattern and agriculture.

The information so derived have been discussed and interpreted in all six chapters to complete the format of the present thesis in such a way that each preceding chapter becomes the base for the suceeding chapter .

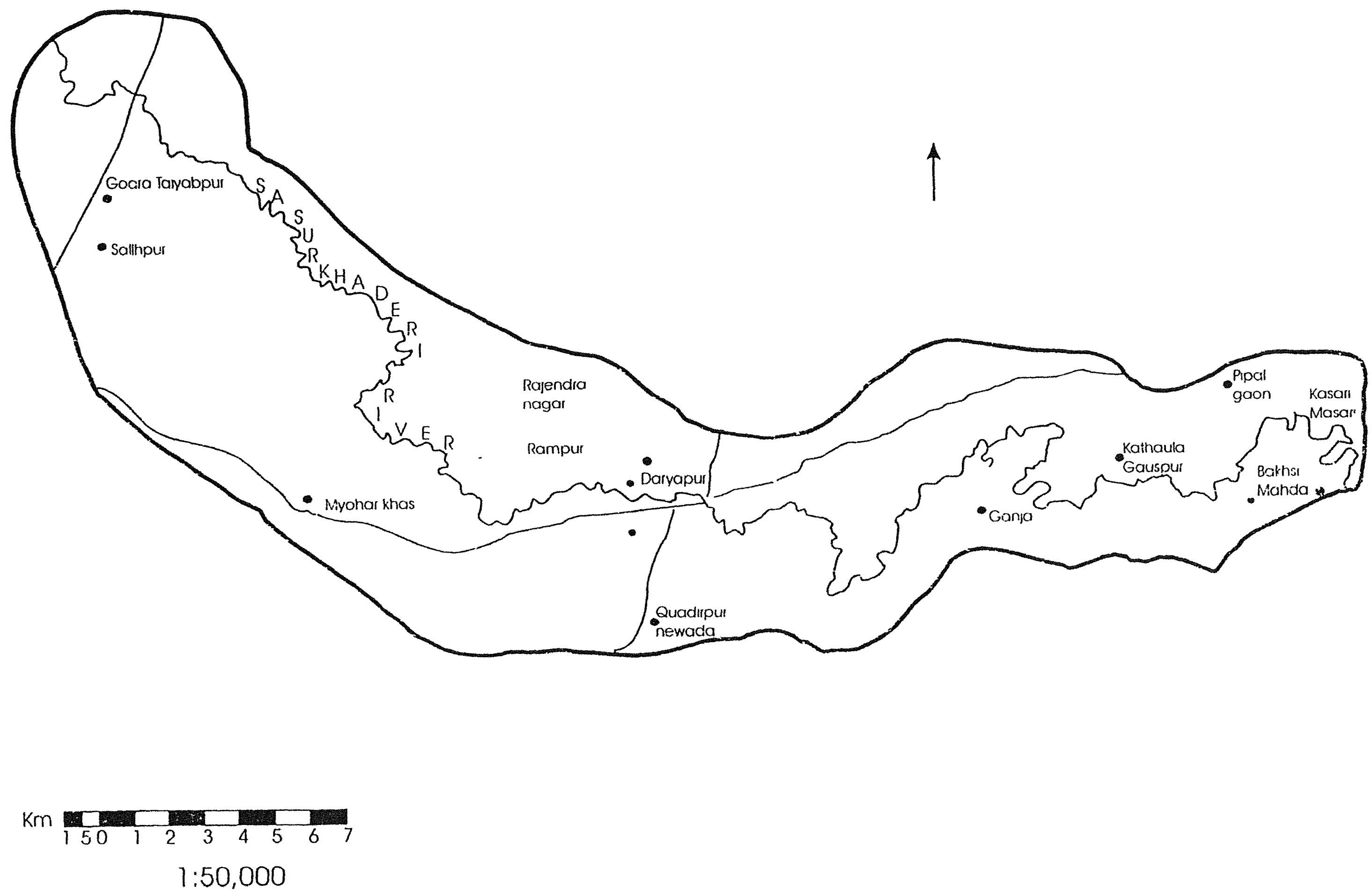
CHAPTER- 1

PHYSICAL BACKGROUND

LOCATION:

The study region ,the lower Sasurkhaderi river basin ,is the part of doab of Allahabad (now called Kaushambi from April 1997) district which is situated in northern Indian plain of river Ganga and Yamuna. Sasurkhadri river is a tributary of river Yamuna . It is a rainfed river which remains dry during the most part of the year except the rainy season. It arises from upper part of the Fatehpur district and flowing towards south easterly direction it enters the sirathu tehsil of the Kaushambi district .After completing a course of the fertile Doab area of Ganga and Yamuna in the Kaushambi distict it finally loses its entity into the lap of the river Yamuna near Bakshi-Mahada just about 5 kms upstream from the famous confluence of river Yamuna and Ganga. The lower basin comprising both sides of the river having a length of about 87 Kms (east-west) towards the end is the subject matter of this study. The lower basin has a catchment area of about 30100 hectars and is located between 25'26'40" and 25'32' north parallels of latitude and 81'25' and 81'49 east meridians of longitude. The major portion of the lower basin is situated in Chail tehsil of Kaushambi distriict, and small portion in Maujhanpur and Sirathu tehsil. In the north of the lower basin passes the double

Location Map



broadguage railwayline. The railway stations are Allahabad, Subedarganj, Bamrauli Manauri, Sayed-Sarawan and Bharwari. In the south the basin demarcation passes through usrankala, Sewarha, Gawa and Baraulha panchayat area. In the east are located Karelabagh, Pura Madari and Lukarganj. In the west lies the upper basin of the river partly in tehsil Manjhanpur and partly in Sirathu tehsil of the district Kaushambi. The study region is plain area formed b~~o~~y the sediments brought down by the waters of river Ganga and Yamuna. Fig. No.-1.1

CLIMATE:

The importance of climate as a geographical control is so marked, and reaches into so many aspects of human life, that it would be difficult to overemphasize (Strahler). Climate plays a vital role in determining the distribution, quality, growth and performance of human life. The use of land, vegetation crop cultivation, forest, pasture etc. every thing is determined by the prevailing climate in a region, climate tog~~a~~ether with topography determines the capacity of land to support a population'.

The climate of the study region is sub-humid moderate temperate ·, Long hot summer but only little amount of rainfall during the winter season are some of the characteristics of the climate of the region. The seasonal variations in the region are well marked. The winter season starts from middle of October and continues till the

end of February. The continuation of summer season is from March to May .The south-west monsoon occurs at the middle of June and disappears in middle of September.

TEMPERATUE:

There is an extensive variation of temperature during the year. The temperature begins to fall gradually after the middle of October and January records the lowest temperature in the region. The minimum temperature goes down to about 9°c Table no11 during January. but sometimes owing to spell of cold wave resulting from a heavy snow-fall over the north-west Himalayas, the temperature falls as low as 5°c. Due to clear and higher humidity the frosts are common in the region during the season. Some-times the rainfall happens to occur during winter season also by the north-westerly depressions.Temperature begins to rise rapidly from the begening of march, The maximum temperature occurs in the month of May, the mean monthly temperature occurs in the month of May. The mean monthly in March is about 24 ° c ;and in May 34 ° c, the area becomes the hottest place during May and June when the maximum temperature rises to about 48 ° c. The dust-storms and thunder-storms are most frequent in the hot weather season. The dry and hot winds, locally known as 'loo'. There is a welcome relief from the humid heat, although temporarily, when thunder shower occur, the season of

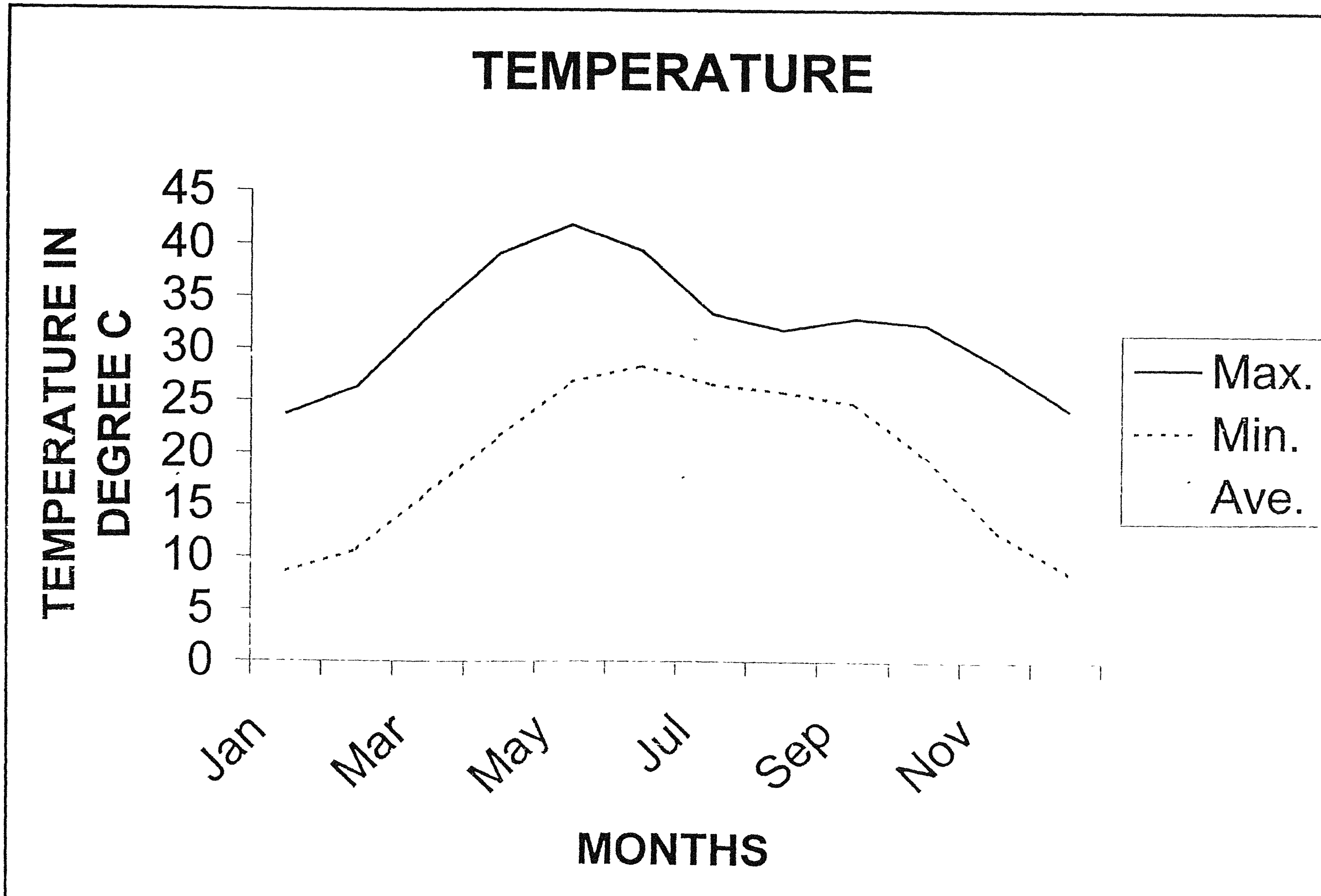

TEMPERATURE
TEMPERATURE IN DEGREE C
45
40
35
30
25
20
15
10
5
0
Jan
Mar
May
Jul
Sep
Nov
MONTHS
Max.
Min.
Ave.

Fig No. 1.2

south-west monsoon commonly in the middle of June, The temperature of day

Table: 1.1

Temperature and Relative humidity
Temperature (in degree centigrade)

Mian Daily			Highest ever recorded with date	
	Max.	Min.		
January	23.7	8.6	31.1	January 29'1934
February	26.3	10.7	36.1	February 27,1896
March	33.2	16.3	41.7	March 30 ,1931
April	39.1	21.6	45.0	April 26,1931
May	41.8	26.8	47.2	May 21,1922
June	39.4	28.4	47.8	June12,1901
July	33.4	26.6	45.6	July 1,1901
August	31.9	25.9	40.0	August 1,1903
September	33.0	24.8	39.4	September 2.1928
October	32.4	19.6	40.6	October 3,1896
November	28.6	12.6	35.6	November 4,1918
December	24.3	8.6	31.1	December 2, 1946
Annual	32.3	19.2	------------------------------	

Lowest ever recorded with date	Relative Humidity (in %) according to Indian Standard time	
	8.30 A.M.	5.30 P.M.
2.2 January 20,1936	80	51
1.1 February2,1905	67	35
7.2 March 2,1906	44	21
12.8 April 3, 1905	32	18
17.2 May 11, 1924	36	20
19.4 June 21, 1930	55	39
22.2 July 22,1955	79	72
21.8 August 23,1953	84	78
18.3 September 12, 1912	80	71
11.7 October 31,1898	68	49
5.6 November 30,1941	67	42
2.2 December 28,1902	76	47
----------------------------	4	45

Source: Allahabad Meteorological Observatory, Bamrauly.

Shows considerable decrease from the maximum of 42° c during the month of May and June to less then 33 ° c in the month of July and August. The maximum range of temperature (about 17 ° c) is observed. 9

HytherGraph

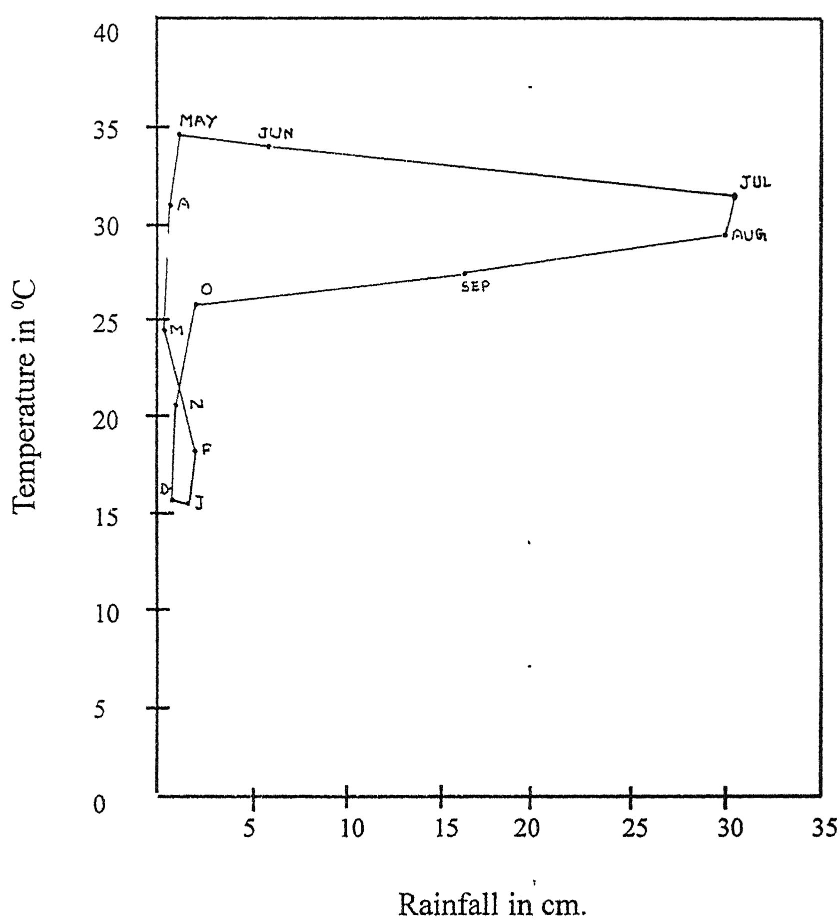


Fig No. 1.3

in the month of April, The lowest range of temperature ($6^{o}c$) is noticed in the month of August due to the high moisture in the atmosphere. Variations in the range of temperature indicates the changing nature of seasons. Fig. No.- 1.2

RAINFALL:

Records of rainfall are obtained from Allahabad Meteorological observatory, Bamrauly. The lower Sasurkhaderi river basin of Allahabad district has three rain gauge stations Allahabad, Sirathu and Manjhanpur which keep, the records of rainfall data ranging from 62 to 96 years, the details of the rainfall at rain gauge stations are presented in table-2. Average annual rainfall of the region is 975.4 mm (38.40") but average rainfall variatioin is very large and some times results in drought condition. Table no1.2discloses that the mean annual rainfall for Allahabad (chail), Manjhanpur and Sirathu is 980.1mm 895,6 mm and 9748 mm respectively (Table no.1.2). The major ;proportion of the rainfall in the region is recorded during the end of September. The season is called as the period of the south west Mansoon. About 70% rainfall occurs during July and August. The distribution of rainy days is directly co related to the distribution of rainfall. The maximum rain has been recorded in 13.6 and 13.7 days in July and August respectively. This concentration of rainy days in these months is not usefull for the cultivation of crops or under ground water table as the maximum run off occurs in short duration,

Table- 1.2 Rainfall

Normal Rainfall (in mm)

Stations		January	Februar	March	April	May	June	July	August	September	October	November	December	Annual
Allahabad (Chail)	(a)	17.0	21.3	9.7	5.3	7.1	80.3	307 6	293 1	182 6	40 4	8 6	7 1	980 1
	(b)	1 6	2 0	1 0	0.6	0.7	4.6	14.1	14.2	8 5	2 0	0 7 .	0.7	50.7
Manjhanpur	(a)	19.8	18.8	7.9	5.6	7.4	60.7	273 6	285 7	166.6	35.8	6 3	7 4	895 6
	(b)	1.6	1 7	0 7	0.6	0.7	3 4	13.4	13.6	7.9	1.8	0 5	0 8	46 7
Sirathu	(a)	16.0	18.3	8.4	5.3	8.6	68 6	300.2	312 9	186.2	36 3	5 6	8.4	974 8
	(b)	1 5	1.6	0.8	0.5	0.8	3 8	12.9	13 4	8 0	1.7	0 5	0.7	46.2
Allahabad district	(a)	17.1	18.9	8.0	5.4	8 5	81 5	301.6	300.5	181 7	38 8	7 1	6.3	975 4
	(b)	1.5	1 8	0.8	0 5	0.7	4.1	13 6	13.7	8 0	1.9	0 6	0 6	47.8

(a) Normal rainfall in mm.
(b) Average number of rainy days (days with rain of 2 5 mm or more)
Source: Allahabad Meteorotogical Observatory, Bamrauly.

This months possesses the surplus water balance and rest of the months get scanty rainfall resulting in to deficit of water balance. In the south eastern part of lower Sasurkhaderi river basin rapid run off of rain water in large quantity causes soil erosion.

The distribution of rainy days also varies corresponding to the distribution of rainfall (table-2) . The average total rainy days in the year are 48. The highest mean annual rainfall occured in 1948 in sirathu (171/%) and the lowest rainfall was rercorded in 1928 in Manjhanpur when it was only 57 percent (table no. 1.3). Fig No- 1.3 shows temperature and Rainfall in Hythergraph.

A continious rainfall for three or four days is not uncommon in the region. The gap of rainy day increases during the month of September In this region the spatial distribution of rainfall records a difference of only about 5 cms from east to west. The western part of the region records the lowest rainfall. The retreating of South-West Monsoon begins after the middle of september and extends upto the month of November. This period is not altogather dry. The number of days receiving rainfall is reduced to two or three only in the month of October. The average number of rainy days during any month of the winter season does not exceed more than two days. The rainfall in the winter months in negligible. The cyclonic storms and depressions from the Meditterenian sea often bring a few rainfall showers which are advantageous for the Rabi crops.

Table- 1.3

Extreme Rainfall (in mm)

Station	Highest annual Rainfall (as % Of normal) and year	Lowest annual Rainfall (as % Of normal) and year	Heavies Amoun (mm)	Rainfall is 24 hour Date
Allahabad	162 (1916)	62 (1941)	393 2	1875, 30 July
Sirathu	171 (1948)	57 (1918)	290.1	1902, 21 July
Manjhanpur	44 (1942)	57 (1928)	249 7	1894, 2 October
Allahabad district	173 (1948)	59 (1918)	-	- -

Source: Allahabad Meteorological Observatory, Bamrauly

HUMIDITY :

The details of relative humidity has been given in the table no 11. During the period of monsoon the air is very moist and at that time the relative humidity remains 70 to 75 percent. After the end of the rainy season the relative humidity gradually declines and during the summers air becomes very dry and particularly in the afternoon the humidity declines down to twenty percent or less than 20 percent.

CLOUDINESS :

During the raining season the sky is covered with thick clonds and in the remaining period of the year the sky remain either clear or cast with light clouds. In the winters for a short period of a day or two the sky is sorrounded by black clouds with the advent of westerly thunder storms.

WINDS :

Generally the wind flows with slow speed through out the year. It is only in the summer seasons particularly in the noon and during the south western mansoon the speed of the wind increases to some extend. From November to April the wind flows mainly from west or from north west. Easterly and north easterly winds blow upto May. In the rainy season the direction of the winds is either from south west to east or from north east to west. The blowing of winds from north east and from east declines considerably by October. In this region the average speed of the wind per hour is 4.2 km. in January, 5 km in

February, 6 km in March, 6.6 km in April, 7.6 km in May, 8.7 km in June, 7.7 km in July, 6.9 km in August, 6 km in September, 3.7 km in October, 2.7 km in November and 3.2 km in December. The annual average of the speed of the wind is 5.7 km per hour.

The rate of evaporation of water from various water storages is greatly affected by the speed and direction of wind. The rate of evaporation is directly proportional to the speed of wind. The months of May and June are characterised by very high temperature and a low relative humidity together with hot wind of summer called 'Loo' having a very high velocity. During the summers the velocity of wind blows out the sands from one place to another in the south east part of the lower sasurkhaderi basin which is nearer to the point of its confluence with yamuna. This results in formation of temporary sand dunes here and there which are submerged under and washed away by enormous volume of water during rainy season. This process of formation and obliteration of sand topography is repeated each year.

SPECIAL WEATHER PHENOMENA :

From the middle to the end of June monsoon season starts. Monsoon depressions originate in the Bay of Bengal and move across the country causing wide spread and heavy rains affecting also the region under study. Thunderstorms accompanied by squalls occasionally occur in the summer and during the monsoon months as well. In the winter season the mornings are after foggy and thunder

storms and dust storms occur sometimes due to disturbance caused by westerly wind the area faces hail storm. The frequencies of this special weather phenomenon of the region under study have been depicted in the table no. 1.4

Table-1.4

FREQUENCY OF SPECIAL WEATHER PHENOMENA

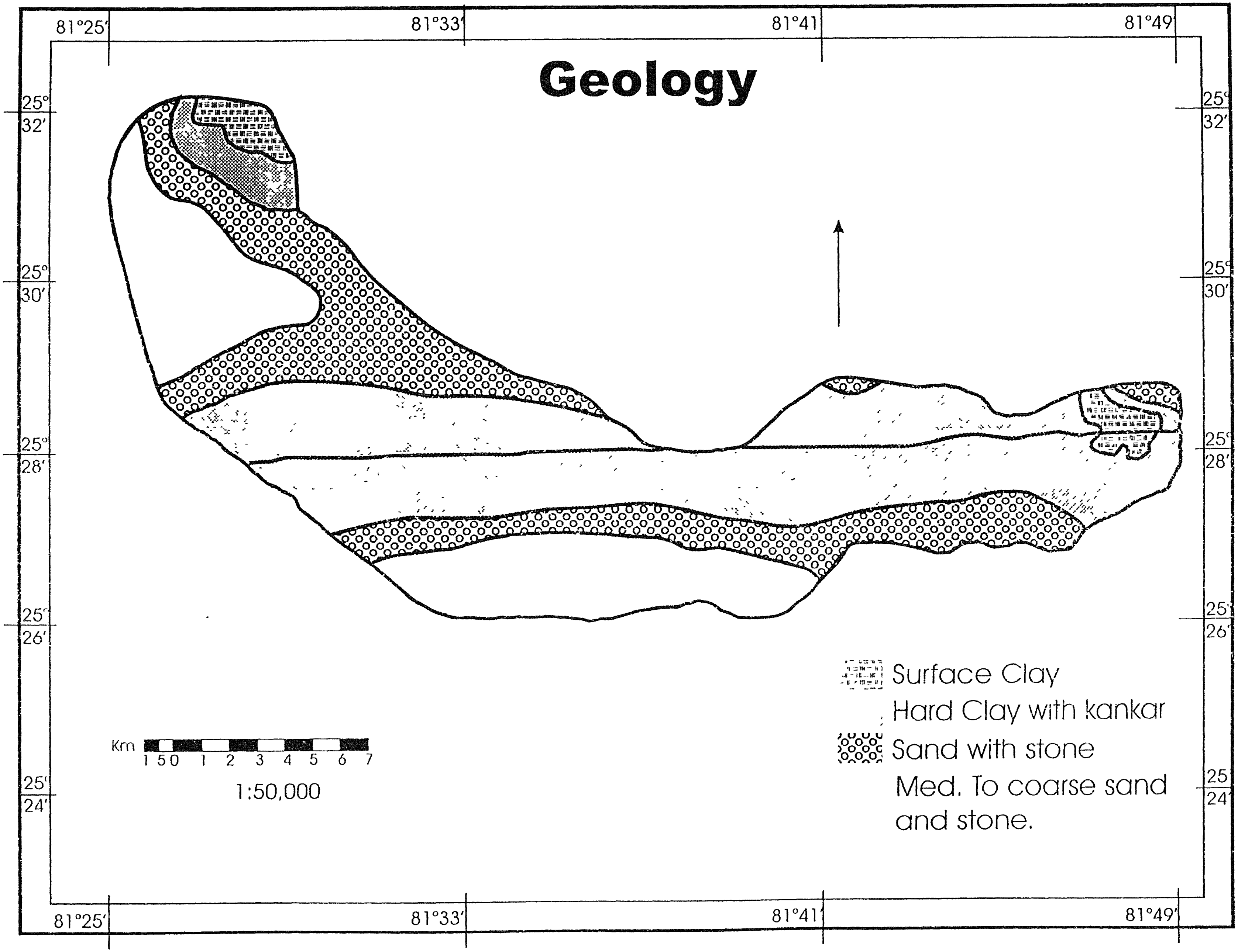
Month	Thunder	Hail	Dust-storm	Squall	Fog
January	2.0	0.0	0.0	0.5	1.7
Feb.	3.0	0.5	0.	0.5	0.9
March	2.0	0.1	0.2	0.7	0.3
April	2.0	0.0	0.7	1.0	0.0
May	3.0	0.1	2.0	0.7	0.0
June	8.0	0.0	0.3	0.6	0.0
July	11.0	0.0	0.3	0.6	0.0
August	7.0	0.0	0.0	1.6	0.0
September	8.0	0.0	0.0	1.1	0.1
October	0.6	0.0	0.1	0.1	0.1
Nevember	0.0	0.0	0.0	0.0	0.0
December	0.7	0.1	0.0	0.0	0.0
Annual	47.3	0.8	5.1	9.8	4.7

Source: Allahabad Meteorological Observatory Bamrauli.

GEOLOGY:

In the geographical study of a region the knowledge of geological structure is fundamental requirement. The structure of rocks directly influences the soils and mineral resources of a region. The agriculture, industrial growth and economic progress of the country also depend indirectly on the geological structure. The alluvial soils brought forth by sedimentary rocks are very useful for agriculture e.g. the rivers having eroded the sedimentary rocks of the Himalayas have formed the fertile plain of the northern India.

Geological formation of the study region can be described on the basis of structural characteristics during the period of its formation and reconstruction. The formation consists of alluvial deposits of Aryan group formed during quaternary epoch of recent and Pleistocene ages (wadia-1957). The entire study region is composed of Gangetic alluvia, The deposition of this alluvia started in the Pleistocene period after the final upheaval of the Himalayas and is still continuing (Auden, 1933). The alluvial debris of the Vindhyas is found in the north of the study region specially where the Vindhyan rock series extend to the north of the Yamuna. The upper layer deposit of yellowish color seems to be laid down by the Ganga river. The composition of Gangetic alluvia is the fluvial deposition of sand, silt and clay. The nodular concretions of CaCo3 (calcium carbonate) and other chemicals form large to small lenses with in alterations (Dubey,



Geology
81°25′
81°33′
81°41
81°49′
25° 32′
25° 30′
25° 28′
25° 26′
25° 24′
Surface Clay
Hard Clay with kankar
Sand with stone
Med. To coarse sand and stone.
Km 1 5 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 1 4

A., 1985). The over all thickness of alluvia is of the order of a few hundred meters. Fig no. 1.4

DRAINAGE

The river of the region Sasurkhaderi drains from north west to south east direction. The course of the river is parallel to that of the Yamuna with in the central depression of the Doab. The river originates from the western uplands of Fatehpur District having only a seasonal flow of water during and immediately after the rains. It grass and develops with the supply of water from many small streams joining the river on the north and south banks in the region. Fig no. 1.5.

Sasurkhaderi river enters Kaushambi district near Nandiamai village on the western boundary of Sirathu tehsil and flows towards south-east Moving beyond the village Baranpur Kadipur Ichauli situated in Sirathu tehsil this river flows through tehsil Sirathu and chail on the left and Manjhanpur on the right and forms their, natural boundaries, Before reaching Arka Fatehpur in Manjhanpur tehsil this river flows in this tehsil for about three. K.m, Again forming boundary upto 3 km between Manjhanpur and chail tehsils this river reaches Udathu from where it enters Chail tehsil. After flowing up to 5 km in this tehsil the stream of Kilnahi is absorbed in it and making a boundary between the two tehsils it enters again Chail tehsil. The river

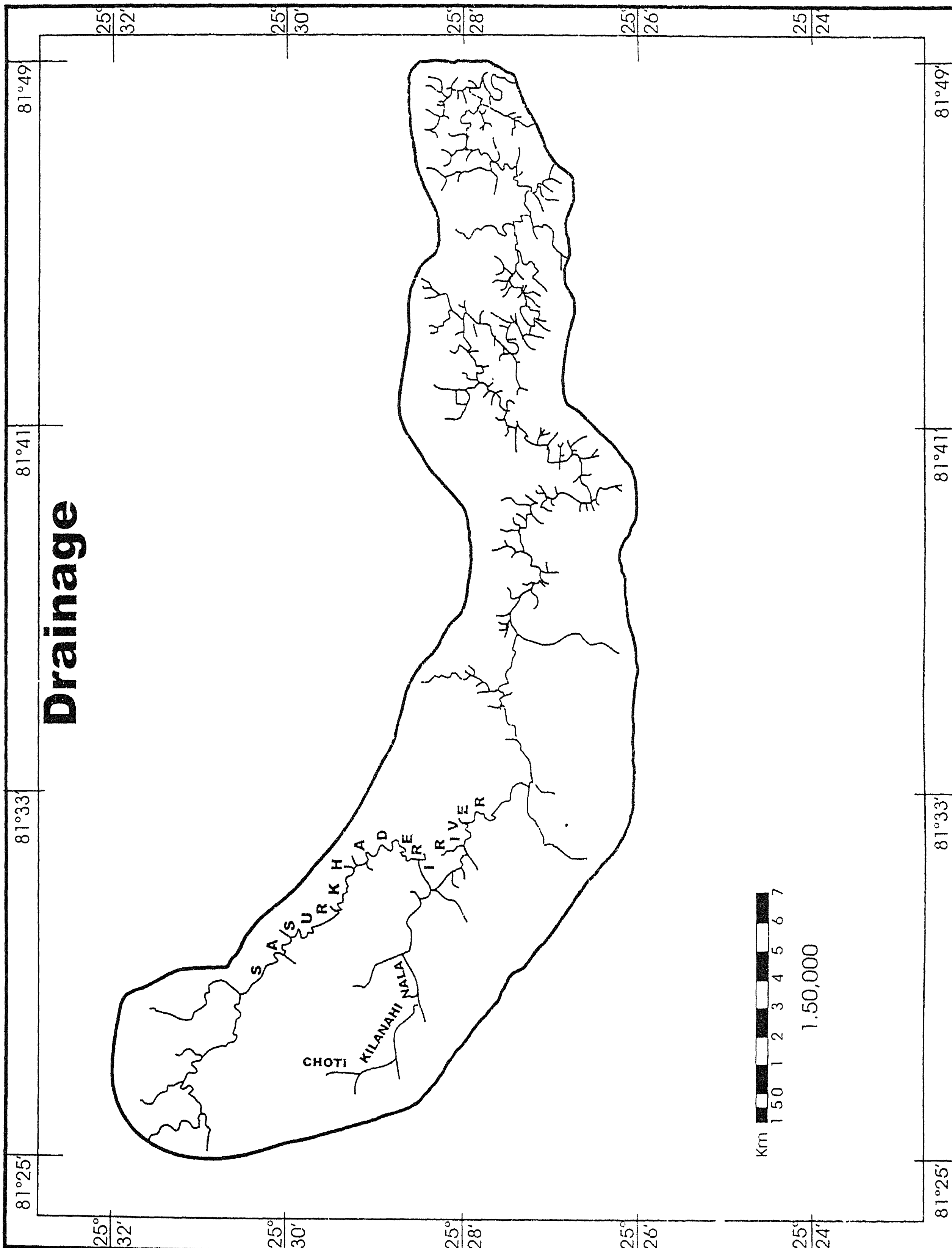

Drainage
SASUR KHADERI RIVER
CHOTI KILANAHI NALA
1.50,000
Km
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
81°49'
81°41'
81°33'
81°25'

Fig No 15

again progressing in a zig-zag way towards east loses its identity in the river Yamuna on the left bank near the village colled Bakshi mahda located in southern outskirt of Allahabad.

The banks of this river levels with the eartn surface of the contiguous villages but when this river flows through the limits of tehsil Manjhanpur its flow becomes deeper and its banks contain a number of abysses. After mingling of the kilnahi, the number and expanse of the abysses have multiplied. This river performs the function of the central water drainage system of the doab area

During the summer, this river dries but it retains dampness in its bed and at places particularly near its confluence with the Yamuna sandy marshes are noticed. In the monsoon months the water level of the river is changed, rising with in a few hours after heavy rains. Consequently, the river is over flooded and the volume of water is enormous. After the rainy season water in the channels subsides gradually. The river is eventually reduced to dry beds of sand. Towards the east, however. The stream approaches the flat alluvial plains and the banks are unconsolidated due to the deposition of sands and clays Agriculturally this river is not very important for irrigation.

SOIL:

Soil plays a very crucial role for a country like India where over 70 percent of the people earn their live~~ly~~li-hood either directly or

indirectly from agriculture. The distribution and density of population always depend on the existing pattern of soil fertility and productivity.

Soil is that part of the regolith that support rooted plants Chaster R. longwell and Richard F. Flint) . Climate and topography are controlling factors of soil. A systematic study of soils logically follows a study of climate and land forms, because both are essential foctors, in soil making (A.N. Strahler). Fertility of the soil depends upon its physical and chemical properties and also the processes that make the soils. The need of soil study in the field is essential as it plays an important role in the distribution of crops, better crops and higher yields. The physical and chemical properties of soils are the major determinants of water retentivity and fertility.

Influence of physiography and climatic environment on the soil formation is reflected and it suggests the types of soil present in a region. Many geomorphologists have studied the inter relation-ship of soil formation and physiography in different environments

A close relationship between soil and corresponding landrorm units developed by geomorphic process in the weatern Rajasthan was observed by Roy B.B. (1967), Gawande and others (1977) from black soil region and the result of their observation was that the features of soil such as depth, solum, colour, drainage, and texture etc are mostly influenced by the variations of land forms and such other characteristics. This may also be stated to be the reason for variation

of characteristics and classifications of soils. Similar variations are also reported by yadav (1977) at Vindhyan plateau in Uttar Pradesh in respect of topographical gradations on Catena basin. Hilwig and others (1971) observed from the upper Ganga plain in Uttar Pradesh that soils and landscapes are closely related on micro level and by identification of land forms soil properties can be interpreted, Govindarajan (1972) reported that geomorphic variations are responsible for the distribution of different soils in Karwar district of Karnataka under subhumid climate. Similar Variations are observed by Murthy and others (1974) at Royal Seema region in Andhra pradesh. So the interrelationship of geomorphological features has been studied in this chapter under geology, keeping in view the impact of different land form units on the characteristics of soil development.

The tract of the Doab between the two rivers, the Ganga on the north and the Yamuna on the south is covered by broad strip of fertile alluvium soil which at places narrows down occasionally. Alluviam covers nearly 80% of the area of the region and constitutes the continuation of the alluvial plains. It has been formed by deposition of silts brought down by the rivers. The alluvial deposits can be classified into two types. The older alluvium occupying higher levels and newer alluviam covering the low lying areas subjected to early floodings.The older alluviam is of sandy type and is composed of lime

and ferruginous concretions while the newer alluviam is of the finer texture and free from ferruginous concretions and lime.

The eastern part of the region consists of a number of ditches and cavities.The soil is slightly dumat here and changes in to hard clay at central portion of depressed land of Sasurkhaderi river. There is follow and uneven belt of soil along the banks of Sasurkhaderi river.

The fallow land is mainly confined to the area where this river meets with Yamuna. Near the confluence this river has many rills and gullies along its bank. From centre of depressed land to higher portion of Yamuna along south soil changes to dumat.

NATURAL VEGETATION:

The natural vegetation is closely related to relief, soil and climatic conditions in a region. Thus, it is necessary to consider its role in the study area.

Natural vegetation plays the leading role is the process of soil formation. It has been a necessity to preserve the soil and fertility of land. The leaf-fall is rich in mineral constituents .

Ground vegetation is the source of organic matter in soil. The upper layer contains most of the organic material subsoil is poor in organic content. The natural vegetation expresses the summation of the climatic factors under which it grows, though there are plant

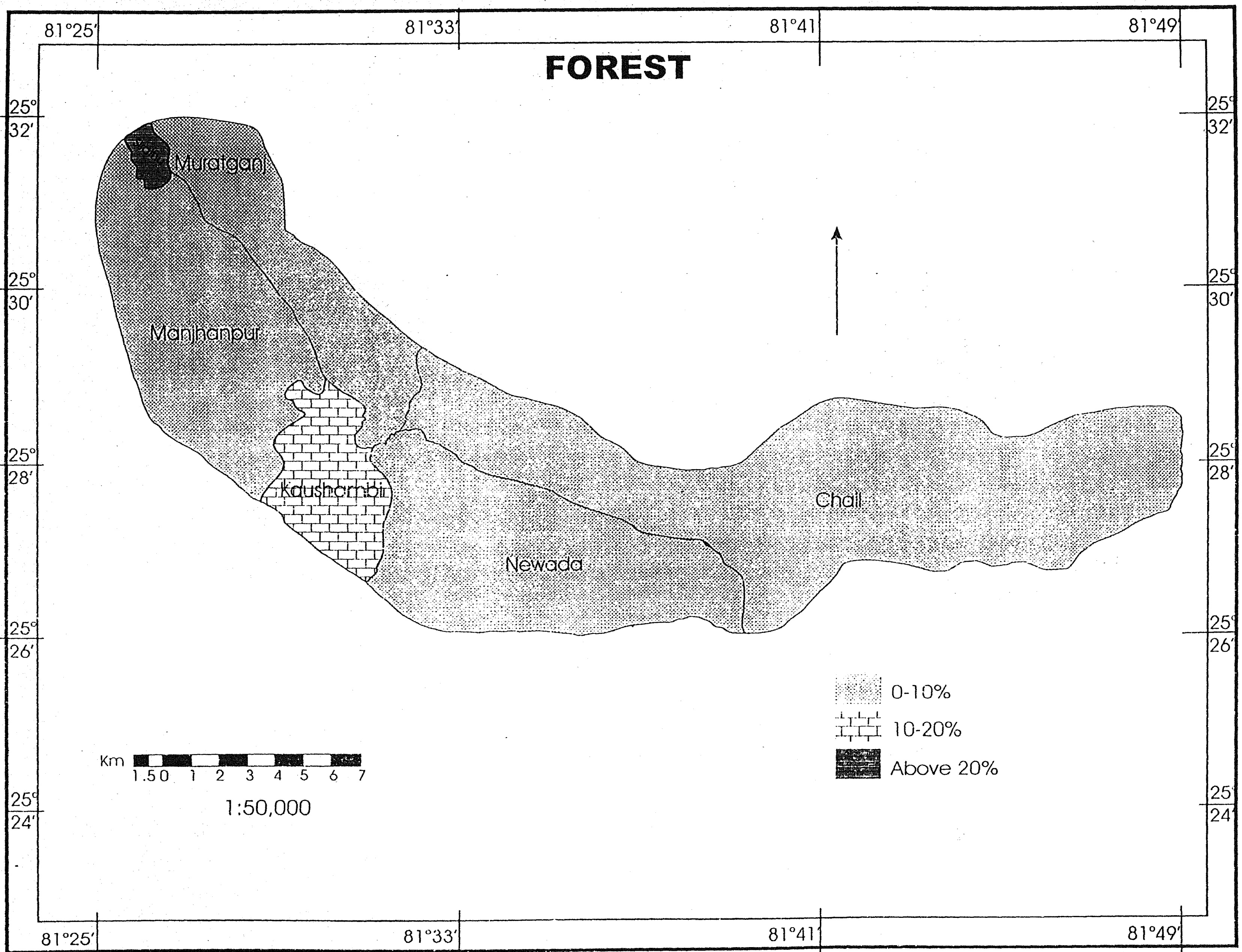

FOREST
81°25′
81°33′
81°41′
81°49′
25° 32′
25° 30′
25° 28′
25° 26′
25° 24′
Muratganj
Manjhanpur
Kaushambi
Newada
Chail
0-10%
10-20%
Above 20%
Km
1.5 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 1.6

association whose occurrence is determined mainly by soil condition, while in other cases the operation of climatic factors may be modified by the character of the soil. Even in a region of typical forest climate, local factors, topogoaphy and drainage may lead to the development is the extreme humid condition. The forest of the region extend over an area of about .013% of the total area. This percentage is lower than what was recommended in the national Forest policy, i.e., 33 percent in plains and 60% in the hills. The natural vegetation are distributed more or less evenly through-out the region except the mouth portion of Sasurkhaderi river due to Social Forestry, Figure no. 1.6 shows the block wise distribution Figure no. 1.7 of natural vegetation shows the social forestry distribution. The shape and size of natural vegetation depends on the terrain. In general, the low lying areas and gentle slopes with deep soil have been brought under the plough. Population as also the general poverty of land have been instrumental in the excessive cultivation across the forest fringe in productive areas. The natural vegetation in the region is Tropical Dry Deciduous according to the classification of the forest types of India.

In comparison the western and south western tracts where agriculture is the poorest, the forest have practically disappeared due to human interference. The influence of vegetation on soil in the area is not significant. Deforestation on the western part induce soil erosion and consequently there are no proper development of soil

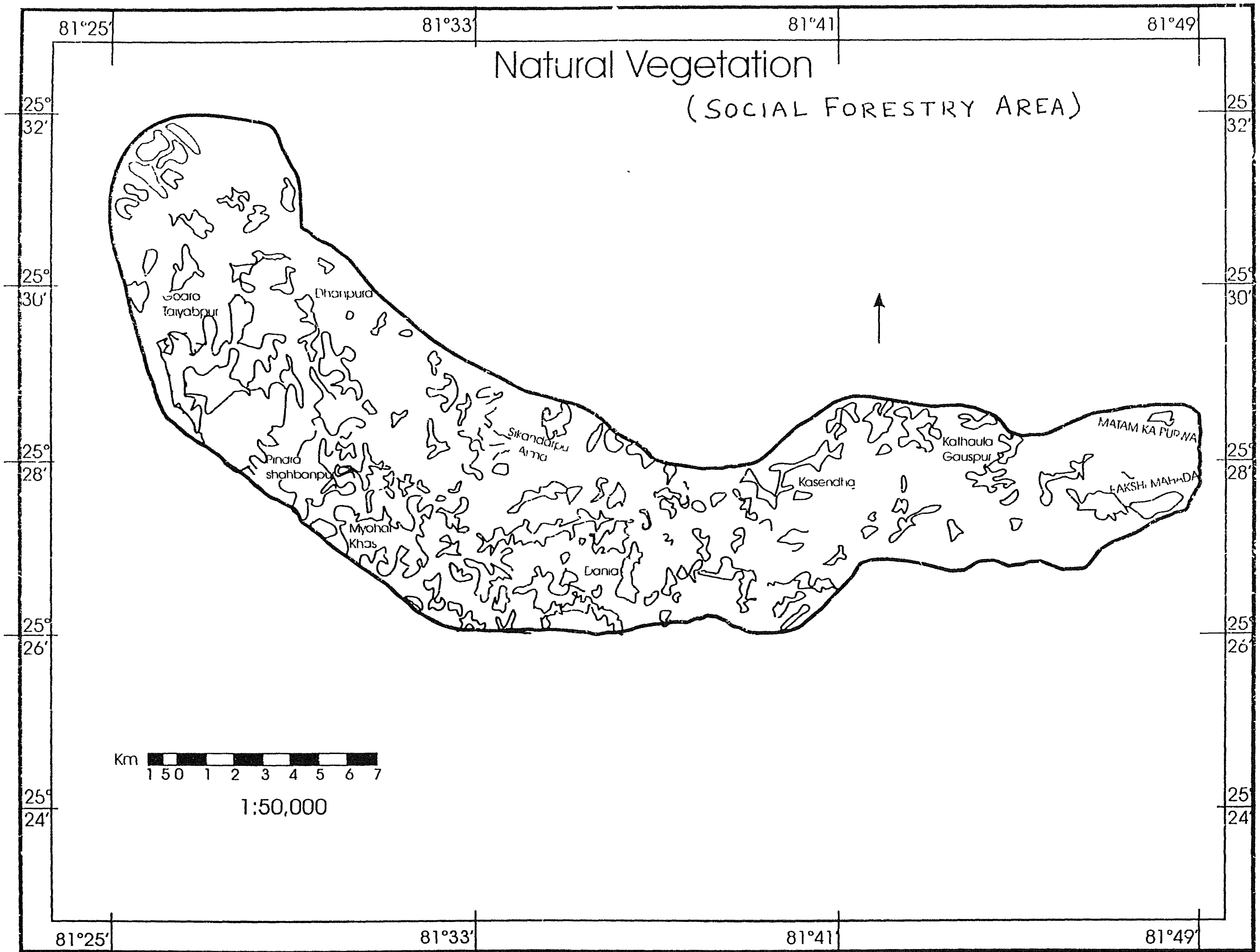

Natural Vegetation
(SOCIAL FORESTRY AREA)
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
Dhanpura
Taiyabpur
Sikandarpu
Arna
Pinara
shahbanpu
Myohar
Khas
Dania
Kasendha
Kathaula
Gauspur
MATAM KA PURWA
Km
1 5 0 1 2 3 4 5 6 7
1:50,000

Fig No. 1.7

profile, Eastern area, of the region have very low amount of organic carbon because this is the forest free area, so sufficient amount of stable manure as well as chemical manure is to be supplied for successful agriculture.

In the entire area under study there is no natural thick forest except some trees, orchards and growth of scrubs on the barren lands. The causes of excessive reduction in the natural forest are grazing by animals, trimming of branches and irrational cutting and felling of trees on a large scale during the past several decades. Due to these reasons the lavel of the area looks devoid of trees. During the recent few decades vigorous efforts – have been made for the plantation of trees on personal level as well as under governmental encouragement particularly under social forestry scheme. If adequate steps are taken to save the planted trees from fire, grazing, irregular felling and branch trimming the area can be covered with good looking forest.

Efforts of forestry and present condition

Patari i.e. path on both sides of roads, canals, and railway lines in addition to bare forest parts and land of the gram samaj have been included in schemes of forest development the succeeding paragraphs give a short description of each type of forestry:

Roadside forestry- Most of the old road side plantation exist on both sides of the roads which were grown by planting shadowy trees at

intervals of 12 metres in continuous rows the plantation were done on ~~the~~ both sides during the same period of time. But shadowy trees of the same specics and of similar age are less in number. It appear that in_itial by trees of same specics were planted and grown but with the passage of time many of them either died or were felled for obtaining wood and in the vacant spaces trees of different species were planted. In all probability the initial efforts had been to grow trees of the identical species but due to plantation of new trees in the vacant spaces it is now found that there is mixture of new and old trees in the shadowy rows. In the Pakar, sheesham, mango, Neem, jamun, Imli, Arjun, kala siras, Peepal, kanji, Bargod etc. are found in linear existence. Trees such as eucaleptus, prowpis, sheesham etc are mostly found in the new road side plantation. Besides mixed plantation of Baheeta, white syrus, kath sagaun Argun, akelic, Aricalifernis, kachnar, Amaltas, Pakinsonia etc. are visible at some places.

During the last two decades new ~~treases~~ have been planted in place of old trees. These plantations have mostly been done in two to three continuous rows where ever place had become available. There are manily plantations of sheesham, mango, jamun, Arjun, eucaleptus. After 1970 the plantation of eucaleptus hybrid has been done in much larger numbers as compared the plantation of trees of other species.

After 1975 onwards the system of plantation in multilinear rows was adopted and the intervening distances between the trees were

reduced. At some places multi row system of plantation of Argun, kanji and jamun has proved successful and within a few years they have been transformed into shadowy rows.

After coming of the road side plantation under the control of the forest department the trees planted in the vacant space are found to be of equal age group. In the rows of trees on the road side and on the outside of the patris ofens five rows of Babul were raised and in some places seeds of babul were sown on the mounds. These Babuls on growth have become dense. On some parts of the road side, which are barren, plantation of porsopis have been done and these have proved a success.

Under growth is almost nil. In most of the pataris the land below the trees is vacant where at some places shrubs have come into existence.

Many of the trees are of adult and distorted uneven growth. Their growth is negative. Plantation of trees on the pataris of canalsides.

TheIrrigation department had planted trees on the patries of both sides of the irrigation channels. There are mostly in one or two shadowy rows and the trees are Jamun, Sheesham, Mahua etc. The forest department has taken up the plantation of trees on the sides of irrigation channels under the social forestry scheme from the year 1979. In order to fulfil the needs of the villages the system of multi

row plantation as adopted on the road sides is being done on the pataris of the irrigation channels. Eucaliptus is the main specie which have been planted. In addition to eucaleptus plantation of kanji, jamun sheesham, kesia syamine has also been done. But mostof the pataris on the sides of irrigation channels are still vacant which can be utilized for plantation in the coming years.

Plantation on the sides of Railway lines- Most of the patari lands on the sides of the railway lines are still vacant. At some places however old trees of sheesham, Neem, Jamun and Mahua come to sight. In the remaining portion, the land is either water-logged or covered with shrubs of Ber etc. New plantations are generally unsuccessful. Instances of Babul, Porosopics etc. are visible here and there.

Land of Gram Samaj- The land of Gram Samaj under the forest division are mostly fallow and unutilizable. Vegetation is almost nil in such areas. After contractual agreement with the Gram Samaj sabha. The forest department has planted trees which are most successful.

Successful efforts have been made by the forest department to plant species of foreign origin on a large scale which manily include kesia siamia (Bohi) Acasia driculoformis (Australian Babool) Eucaleptus hybrid, prosopice syuliflora

Factors affecting plantation- The factors detrimental to plantation may be classfied into:

(1) Natural agents and (2) Animate agents.

The natural factors harming plantation are drought, flood, water logging, frost and storm. Droughts cause excessive harm to planted trees and vegetation. The main reason of drought are prolongation of summer delay in arrival of monsoon, paucity of rains. During the years 1979, 1981, 1987 delayed monsoon and lesser rain fall immensely harmed the plants in the plantation areas.

The plantation areas are generally surrounded by rain fed or perennial rivers which ~~are~~ over flooded due to heavy rains. In the months of August and September flood causes havoc in the low-lying areas ~~and~~ causing water logging. In these months sides of the roads and railway canal patries are submerged under water, damaging the plants.

Stream cold or frost is another natural cause of damage to plants. In the months of December, January and February some times frost damages the newly planted trees. Babul is mostly effected because it dies from frost and does not sprout again.

Storm and violent Depression also cause heavy damage to the trees. Many times trees are rooted out and fell down. shesham, trees planted on mounds and eucaleptus trees are mostly affected. Single row plantation is more damaged than the multi row system of plantation.

Damage Caused by animate agents- Most of the damages is done by human activities such as illegal felling of trees. uncontrolled grazing and branch trimming. Illegal felling and cuttings of trees have damaged mostly. Dalbergia sisa (sheesham) and acacia (babool) trees. Exotic acacia trees are subjected to illegal felling on a large scale. Branch trimming is common in almost all specics of trees but it affects mostly Neem, Gular, Pakar, Peepal, Bargad Siras and sheesham. Branch trimming is mostly done for fodder but it is often done for use as fuel. New plantations are often damaged by children, shephards and herdsmen, They break the branches of the plants or root out the plants. Farmers often damage trees by transgressing the forest land and road sides adjacent to their fields.

Local population traditionally tame domestic animals like cows, oxen, goats and sheep etc. The grazing and feeding of there animals put pressure on the soils and effects forest plantation undomesticated animals like Neelgaya and pigs etc damage the trees. Trees and plants along the banks of canals and railways sides are damaged by monkeys, rats and rodents.

White ants are the real foes of the trees. They enter the stem and trunk of the planted trees and ruin them entirely. Worms insects, reptiles of various categories and species damage the growth of plants and trees.

Creepers climbing a tree also effects the growth of the tree. Parasits hoppers and fungi etc also prove harmful to the vegetation if protective measures are not taken.

IInd Chapter

TERRAIN CHARACTERISTICS

The lower basin of sasurkhaderi river situated in the doab of Ganga and Yamuna consists of varied topographical characteristics. This area has been created by the soil brought by the rivers. The topography developed by flluvial process is seen there. It is estimated that there is variation in depth of alluvial soil. Newer alluviam is found on the banks of river and older alluviam is found in the outer of these areas. Fallow land is found here and there. To the east the land is a low lying alluvial tract. In the west and south west basin the low lying areas are either bare or covered by low Jungles. In the eastern and south-eastern part of the region the area is broken with a surface layer of more recent alluviam.

The Pattern and distribution of the drainage network indicates the form and process of drainage basin. On the basis of drainage variables drainage density, drain age texture and stream frequency and relief variables , drainage basin can be classified. These morphometric attributes (characteristic quality) reflects the structural, lithological, topographical, pedological and vegetational controls and human activities.

General Relief

In geomorphology the study of relief and drainage are very important. The drainage is the result of relief and it can modify or make the relief also. Taken as a whole, the basin has a wide expanse of gently undulating ground. The slope of the region is generally from north-west to south east and course of the river follows usually the same direction.

The absolute relief of the regoin may be classified into two broad categories of low (0-100) and high (above 100). The lower (0-100) cotegory is found in about 68 percent of the total regional area whereas the areal distribution of high (100-150) cotegory is found in 32% of the total area. The areal extent of low absolute relief (over about 68%) clearly speaks of the flatish and plain topography of the study region. The monotony of the flettish character of the alluvial plain is broken by the gullies and broken bank sites. Fig.no. 2.2 shows the geomorphology of the region.

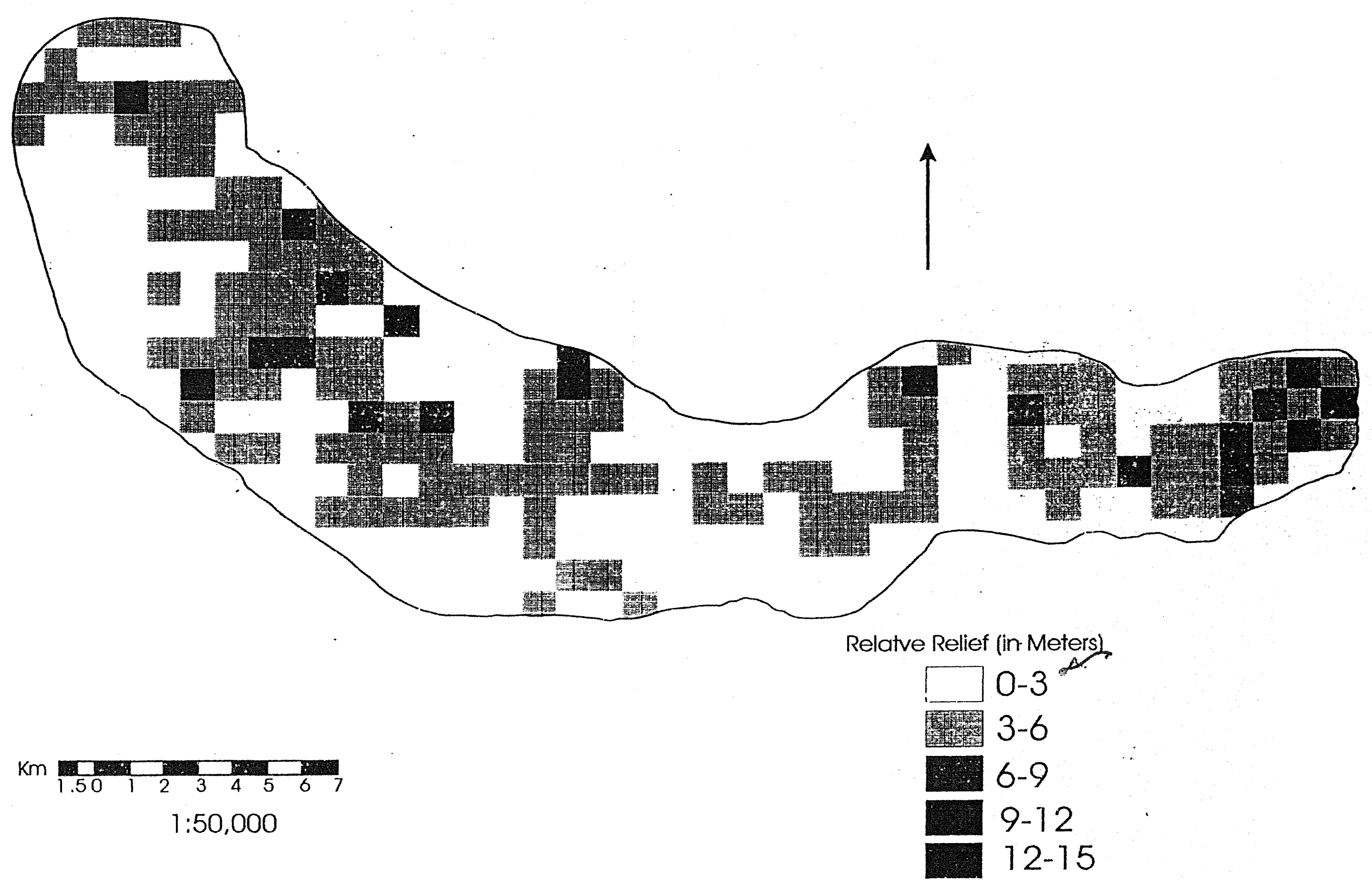
Rel. Relief

Table no. 2.1

Absolute Relief

Classes	Frequency	Cumu. Frequ.	%of Frequ.	Cumu.Frequ.%
0-100	205	205	68.11%	68.11
100-150	96	301	31.89%	100.00

Relative relief



Relative Relief

The variations in the elevation of the earth surface at any point is called relief. From the point of relief the lower sasurkhaderi river basin is almost plane Relative relief developed by Smith G.H. (1935) takes into account of the local relief. He presented a scheme for the study of the relative relief where the difference in height between the highest and lowest point in a unit area is calculated and analysed for the purpose.

Topographical sheets of the study area as demarketed on survey of India map of the scale 1 cm = ½ km was divided into ractangles by longitude and latitude to show the varying altitudes of relative relief by Smith's method.

The study region has been divided in 301 grids. The maximum height difference has been determined within each grid. Five categories of relative relief have been identified for the study of relative relief of the study region.

(0-3) - GR-I

(3-6) - GR-II

(6-9) - GR-III

(9-12)- GR-IV

(12-15) – GR-V

All these groups of relative relief of the entire study region falls under the category of Extremely low category of relative relief.

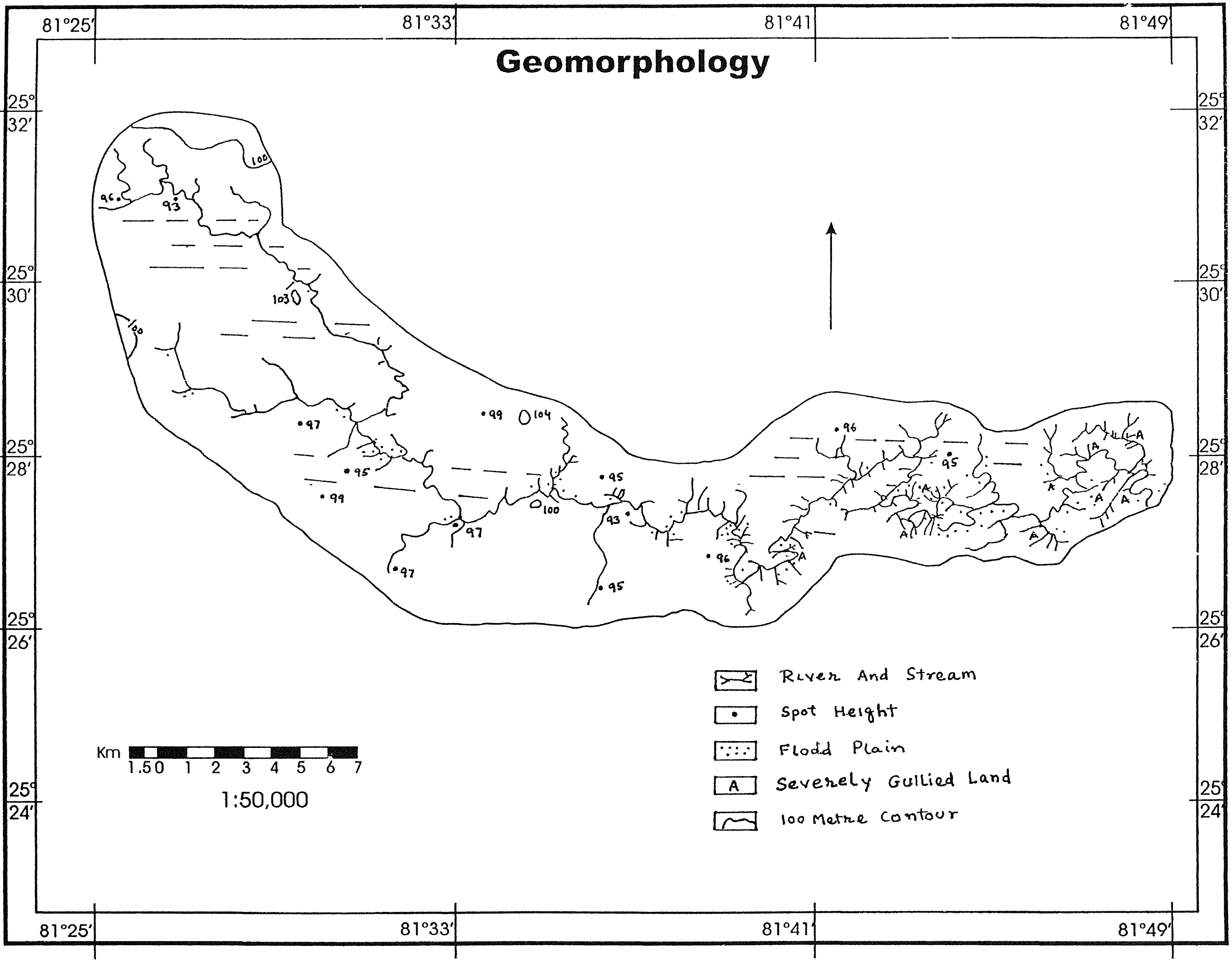

Geomorphology
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
River And Stream
Spot Height
Flodd Plain
Severely Gullied Land
100 Metre Contour
Km
1.5 0 1 2 3 4 5 6 7
1:50,000
100
103
104
99
97
95
96
93
A

Fig. No. 2.1

Table 2.2- Relative Relief

Classes	Frequ.	Cumu. Frequ.	% of Frequ.	Cumu Frequ. %
0-3 GR-I	143	143	47.50	47.50
3-6 GR-II	137	280	45.51	93.01
6-9 GR-III	16	296	5.32	98.33
9-12 GR-IV	3	299	1.00	99.33
12-15 GR-V	2	301	.66	100.00

Mean – 2.9369

S.D. – 1.8035

Table shows that 47.50 percent of the frequencies are distributed in GR-I of extremely low category of relative relief. And 45.51 percent of the frequencies are concentrated in GR-II category of EL category relative relief. Only 5.32 percent, 1.00 percent and .66 percent are distributed in GR-III, GR-IV and GR-V of extremely low category of relative relief respectively.

Spatial pattern of relative relief presents the sequence of variations of relative relief. Relative relief is less than 6 in the maximum grids of the area. Relative relief is 9 to 12 in three grids of the area. Higher relative relief in the east part of basin is in only two grids.

Average slope:

The scientific study of angular inclinations of earth's deformities, which are formed by various tectonic, depositional as well as erosional agencies of exogentetic and endogenetic forces, introduces and lays the foundation of that type of systematic study of landscape, which not only fostered the interests of various dynamic geomorphologists towards the effects of slope in terrain analysis and determination of land scape characteristics on the basis of angular properties but also revolutionizied the whole field by helping in the reorganization and tracing of genetic history of any well defined geomorphic unit (Dr. A. Dubey, 1986). Wentworth's method of slope analysis has been used for the study of the average slope of the area as indicated below-

Tan Q = N x 1/3361+1

Where N= number of contour crossing per mile length.

And I = contour Interval and

3361 = A constant value.

Due to use of metric units of measurement, the formula has been modified as follows tan Q = N x cI (meters)/636.6

Where N= average number of contour crossing per km

CI = contour interval and

636.6= the constant

For slope analysis the same grid pattern as in the case of relative relief analysis has been employed. The average number of contour crossing both along the straight and oblique grid (along sides and diagonals) were counted. For the study of spatial pattern of average slope. The following categories of slope have been recognised and value of average slope have been grouped in 6 categories of slope.

0-0.5 Extremely Level Slope

0.5-1.0 Moderatly Level Slope

1.0-1.5 Level Slope

1.5-2.0 Slopy Level Slope

2.0-3.0 Gentle Slope

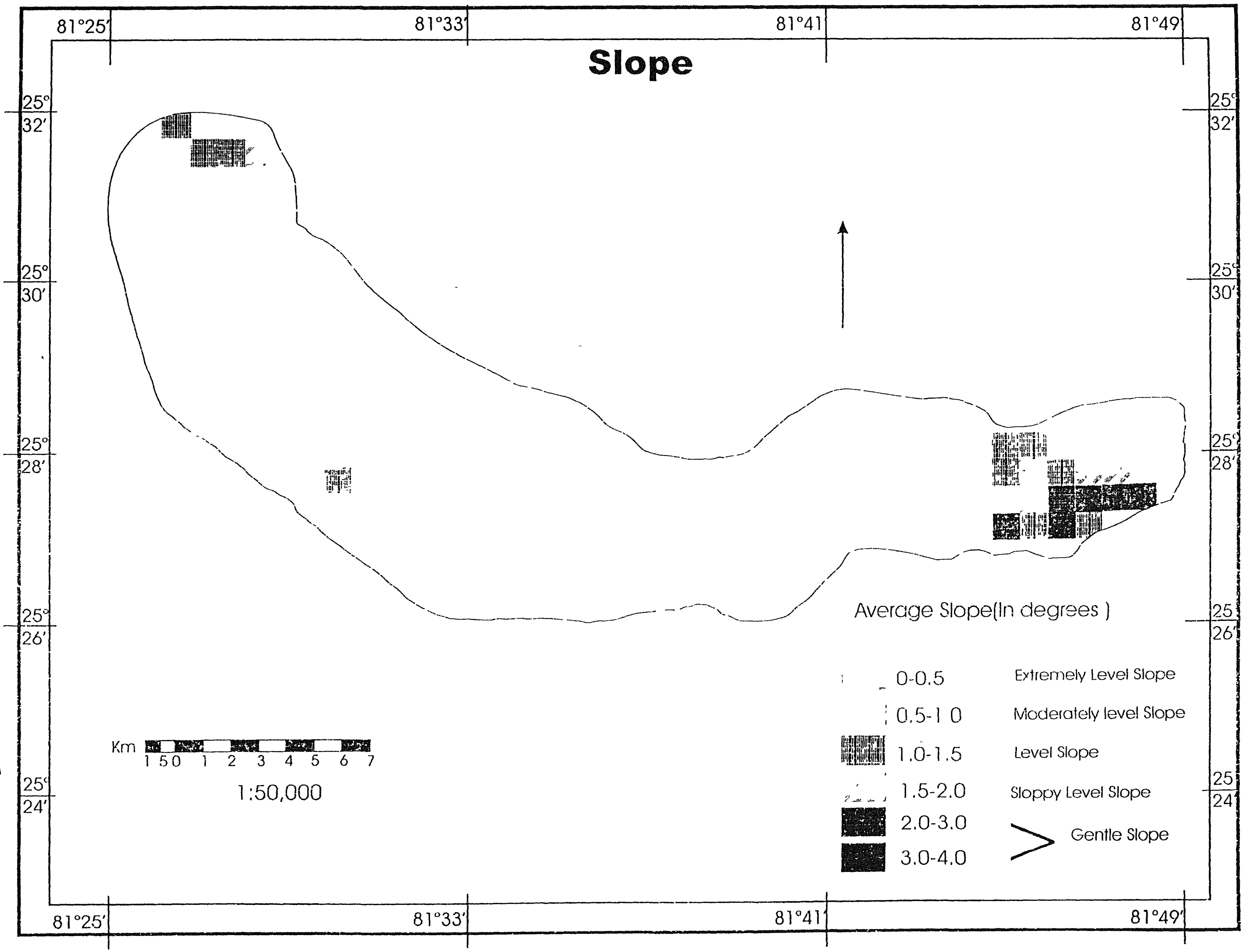
3.0-4.0

Frequency in each category and its percentage of total frequency of the basin have been tabulated.

Table 2.3:Average Slope

Classes	Frequ.	Cumu Frequ	% of Frequ	Cumu. Frequ.%
00-0.5	274	274	91.03	91.03
0.5-1.0	5	279	01.66	92.69
1.0-1.5	11	290	03.65	96.34
1.5-2.0	5	295	01.66	98.00
2.0-3.0	4	299	01.33	99.33
3.0-4.0	2	301	.66	100.00

Mean – 1413, S.D. - .5010



Slope
81°25′
81°33′
81°41′
81°49′
25° 32′
25° 30′
25° 28′
25° 26′
25° 24′
Average Slope(In degrees)
0-0.5
Extremely Level Slope
0.5-1 0
Moderately level Slope
1.0-1.5
Level Slope
1.5-2.0
Sloppy Level Slope
2.0-3.0
3.0-4.0
Gentle Slope
Km
1 5 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 2.3

Table indicates that the entire area lies in the level and gentle slope classes. More than 97 per cent of angle frequencies are concentrated in Level Slope only about 3 percent of the total area of the study region is in the category of Gentle slope. Other higher categories are absent in the study region.

The study region is depositional plain in genesis and is almost a level plain sloping gently towards south east of the region. And at a few places gullies and broken bank sites are found here and there. Fig. No. 2.3.

A close study of table indicates that low classes have high percentage of frequencies and high classes have low percentage of frequencies.

Slope map reveals that the region is almost plane because the region has a range of level slope is about 97 percent of the total area.

Slope gradually increases towards south east part of the area. Here slope varies widely. This area has a slope of more than one degree. In the north slope is less than 2 degree.

Dissection Index

Dissection Index is generally taken as a measure of degree to which the land has been carved by erosion (Ghosh, A. 1984). Method of deriving the dissection Index is the ratio between relative relief and absolute height. Dissection Index is generally used as a morphometric

determinant of the stages of terrain evolution where the values of 0.1, 0.1 to 0.3 and above 0.3 are generally related to penultimate, equilibriumand inequilibrium stages respectively (Pandey, 1983). For the computation of dissection Index various methods have been suggested by many scholars like slaucitays (1936), Desmet (1951) and DorNir (1957). The data thus derived have been classified into the following categories as suggested by singh (1967). But only 3 categories have been found in this study region.

The grid pattern used in the analysis of dissection Index is the same as employed in the relative relief. The value of dissection Index of each grid has been derived and classified into three groups.

0 - .05 Extremely Low

.05 - .10

.10 - .15 Low

Table no.2.4

Dissection Index

Classes	Frequ.	Cumu. Frequ.	% of Frequ.	Cumu. Frequ. %
00-.05	262	262	87.04	87.04
.05-.10	36	298	11.96	99.00
.10-.15	3	301	1.00	100.00

Mean - .0293

S.D - .0179

A.M - .029302326, V. - .000 3218

Table no. 2.4 discloses the fact that more than 99 percent frequencies are falling in the catogories of extremely low category of dissection Index. Only 1 percent of the total frequencies are distributed in low category of dissection Index.

In this low category of dissection Index 87.04 percent of the frequencies come under the first extremely low category (0-.05) of dissection Index and 11.06 percent of frequencies come under second category (.05-.10) of dissection Index.

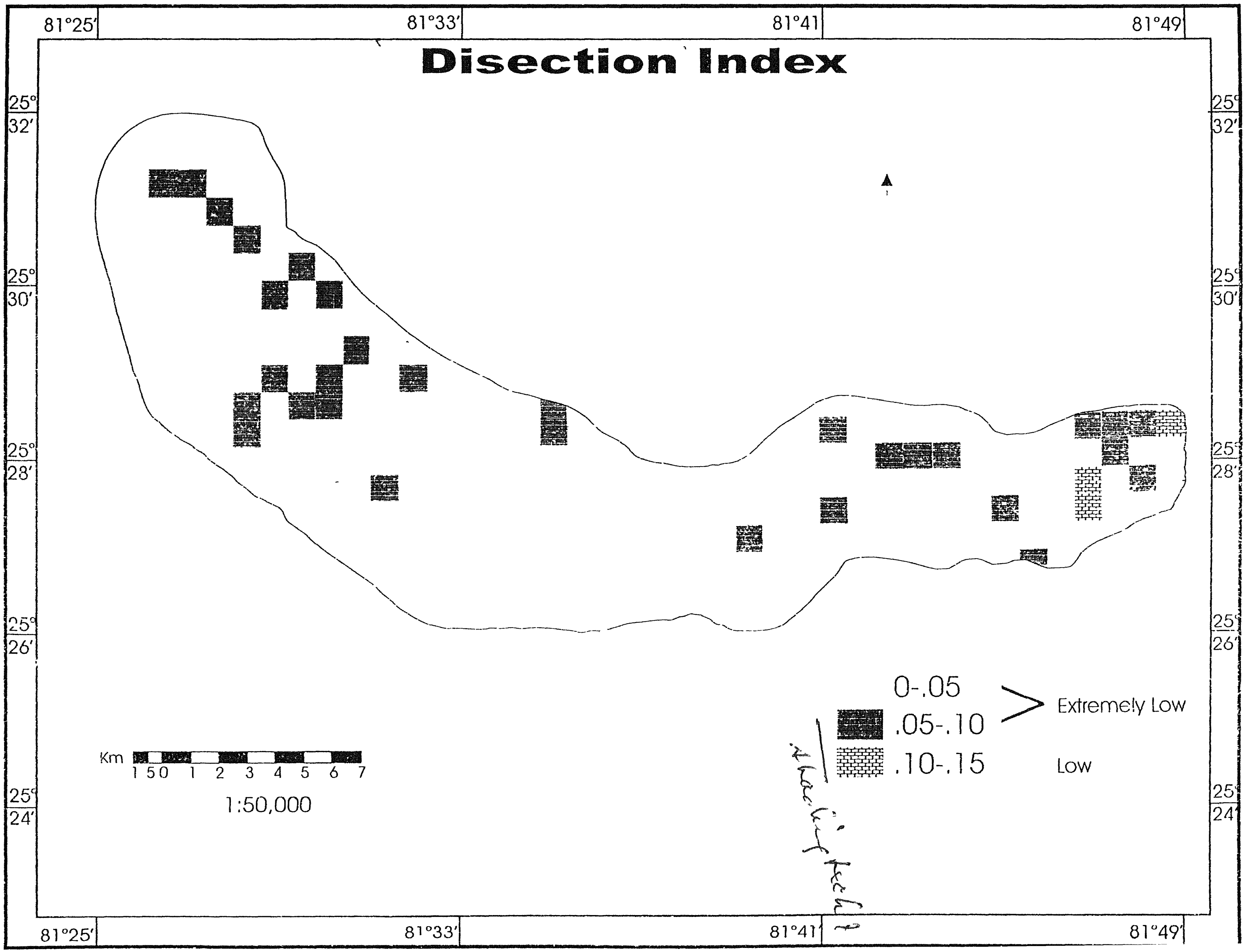
This shows that more than 99 percent of the total area of the study region is very lowly dissected. There is no definite pattern in the distribution of dissection index in the study region, Higher magnitudes of dissection index observed in the only three grids of the study area which occur in patches instead of a continuous zone. Dissection index less than .02 is noted in major portion of the area is found in a scattered and patehy way. (Fig no. 2.4)

Drainage Density

The length of rivers devided by its area gives the drainage density. Harton (1932) defined drainage density as the length of streams per unit of drainage area and proposed the following equation to derive it mathe-matically : $D\Sigma Lk/AK$

Where ΣLK = total length of all segments and AK = total area of the basin.

This method has been applied in the present work for calculating the drainage density. Grid pattern is used to show the



Disection Index
81°25′
81°33′
81°41′
81°49′
25° 32′
25° 30′
25° 28′
25° 26′
25° 24′
0-.05
.05-.10
.10-.15
Extremely Low
Low
Km
1 5 0 1 2 3 4 5 6 7
1:50,000

Fig No 24

spatial distribution of different drainage density classes. The study region has been divided into 301 grid squares of one kilometer each. The value of drainage density for each grid has been determined and plotted to prepare the drainage density map.

Values of drainage density have been grouped into four categories viz. very low (0-2), low (2-4), moderate (4-6) and high (above 6) have been determined for the analysis of drainage characteristics of the study region.

Table no.2.5

Drainage density

Classes	Frequency	CF.	Percent of Frequency	Cumulative Percent
0-2	194	194	64.46	64.46
2-4	57	251	18.93	83.38
4-6	27	278	8.97	92.35
>6	23	301	7.64	100.00

Mean – 1.6588

S.D. – 2.1657

Table no.2.5 shows the trend of high percentage of frequencies in low category of drainage density. More than 83% frequencies are concentrated in the very low and low categories. About 8 percent of the total frequencies are found in moderate category and only 7.64

percent of the total frequencies are found in high categories. Frequency of very high category of drainage density is totally absent is the study region. This shows that on an average, this area is a region of low drainage density.

Figure no. 2.5 clearly indicates regions of concentration of different categories of draiage density. Low drainage density classes are found in about one-third grids of the drainage basin. Drainage density in general, is high in the east and four grids of western part of the basin. The areal distribution of moderate categories of drainage density dominates in the grids here and there.

Drainage texture

Harton (1945) has defined the drainage texture on the basis of the stream frequency (number of streams per unit area). Dr S. Singh defines that the term texture must be used to indicate relative spacings of the streams in a unit area along a linear direction.

$$Dt = As = 1/(t+p)/2$$

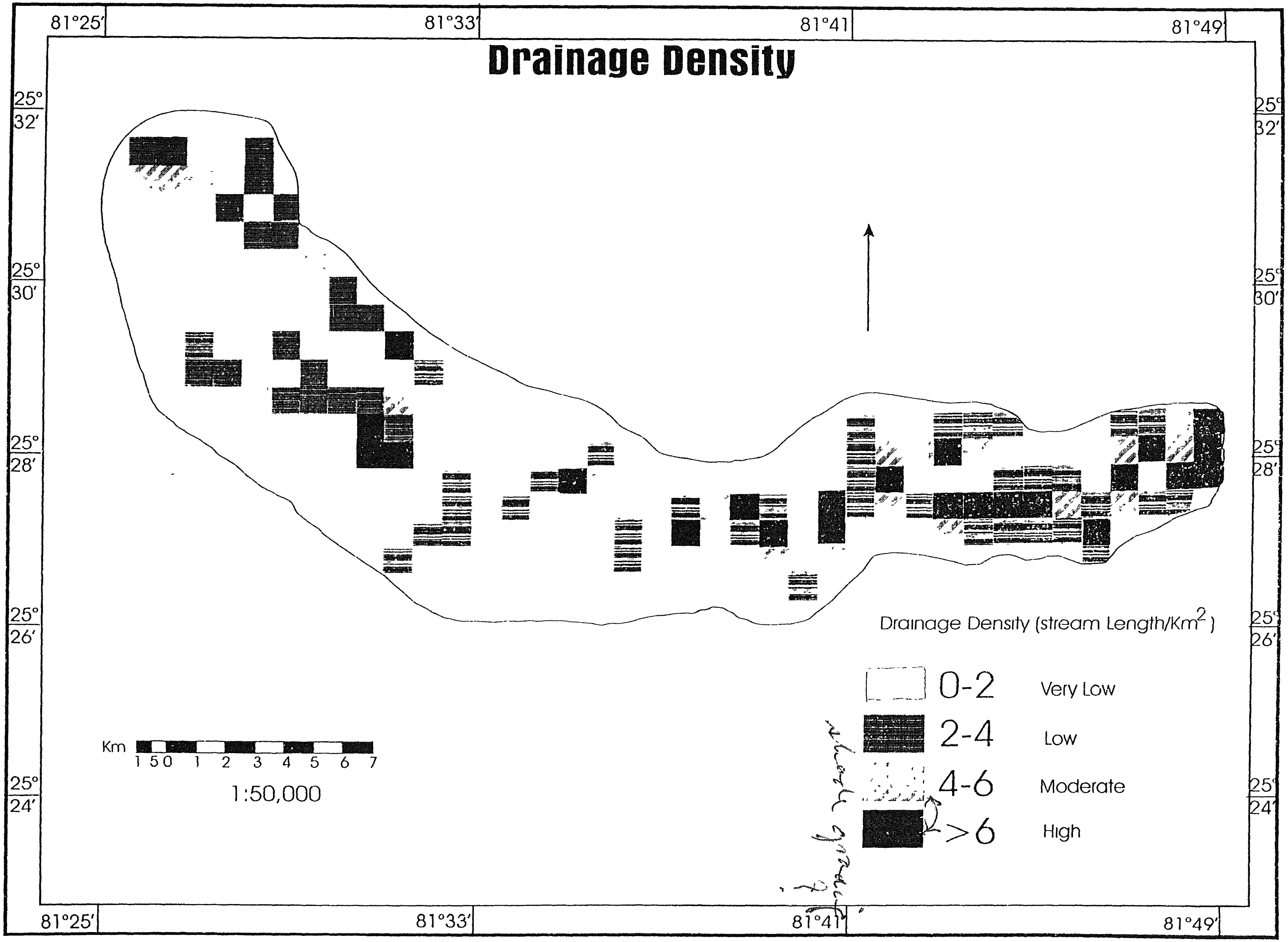
Where Dt = drainage texture

As = Average spacing between streams per unit length.

$$T = \frac{(t1+t2)/2}{\sqrt{2}}$$

Where t1 and t2 = number of intersections between the streams and grid square diagonals.

$$P = (p1+p2+p3+p4)/4$$



Drainage Density
81°25'
81°33'
81°41
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
Drainage Density (stream Length/Km²)
0-2 Very Low
2-4 Low
4-6 Moderate
>6 High
shade gradi ?
Km 1 5 0 1 2 3 4 5 6 7
1:50,000

Fig. No 2.5

Where p1-p4 = number of intersections between streams and four grid edes.

(Dr S. Singh)

Grid-wise drainage texture is same as employed in the calculations of relative relief. The number of stream crossing along both the diagonals should be counted. Further the numbers of stream crossings should be calculated per mile / km length on the basis of the following formula.

The value of drainage texture of each grid of region have been computed and then classified in to the categories of very fine (0-.2), fine (.2-.4), moderate (.4-.6), coarse (.6-.8) and very coarse (above .8). (Fig no. 2.6) A close study of tables brings out the fact that about 45 percent of the frequencies are distributed in the fine drainage texture category (very fine and fine). Where as about 5 percent of frequencies are distributed in the moderate drainage texture and the remaining 50 percent of the frequencies are concentrated in coarse and very coarse drainage texture categories.

Table no. 2.6 indicates that only 44.19 percent of the total area is under very fine and .66 percent of the total area is under fine and 5.32 percent of the area is represented in moderate drainage texture, whereas 7.64 percent of the total area is under coarse and 42.19 percent of the total area of the study region is under very coarse.

Table no. 2.6

Drainage Texture

Classes	Frequency	Cumulative Frequency	Percent of Frequency	Cumulative Frequ. (%)
0-.2	133	133	44.19	44.19
.2-.4	2	2	00.66	44.85
.4-.6	16	18	5.32	50.16
.6-.8	23	41	7.64	57.90
above .8	127	301	42.19	100.00
Total				

Mean – 1.0454

S.D – 1.5244

Stream Frequency

This morphometric varibale has been derived by counting number of stream segments in each grid of drainage basin. The data derived have been grouped into five categories-

0-2 First category of very poor

2-4 Second category of very poor

4-6 Very poor to poor (transitional)

6-8 First category of poor

8-10 Second category of poor

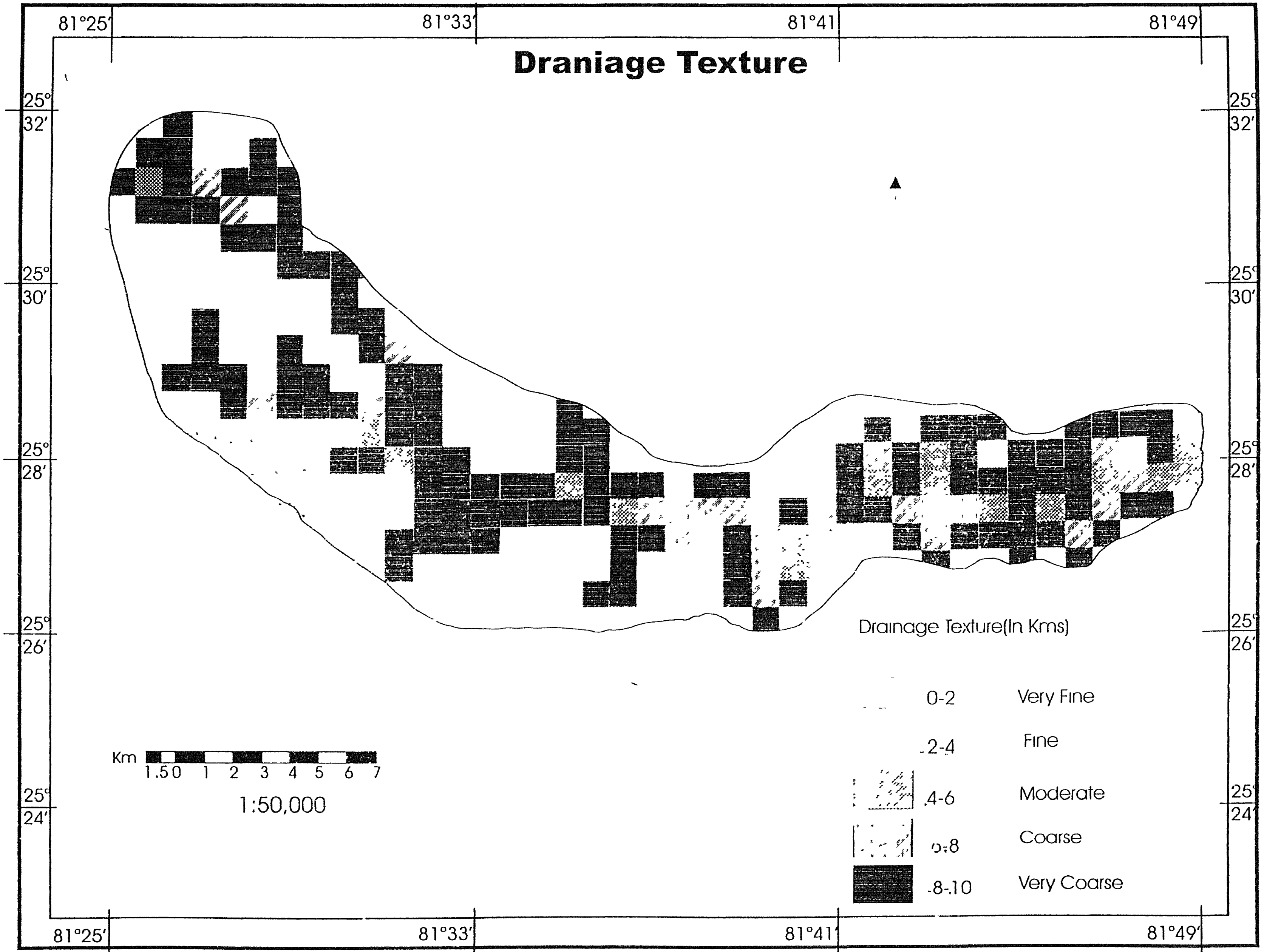

Draniage Texture
81°25′
81°33′
81°41′
81°49′
25° 32′
25° 30′
25° 28′
25° 26′
25° 24′
Drainage Texture(In Kms)
0-2 Very Fine
.2-4 Fine
.4-6 Moderate
.6-8 Coarse
.8-10 Very Coarse
Km 1.5 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 2.6

Frequency in each category and its percentage of total frequency of the basin, have been computed and tabulated. Entire

study region is characterised by very poor to poor categories of stream frequency. Table no. 2.7 indicates that more than 84 percent of the frequencies are distributed in the very poor categories of stream frequency and only 10 percent is concentrated in between very poor to poor (transitional) category and about 5 percent is distributed in poor category of stream frequency.

Table no 2.7

Stream Frequency

Classes	Frequency	Cumulative Frequency	Percent of Frequency	Cumulative Frequency(%)
0-2	198	198	65.78	65.78
2-4	56	254	18.60	84.38
4-6	31	285	10.30	94.68
6-8	11	296	3.65	98.33
8-10	5	301	1.66	100.00

The study of table no. 2.7 shows that frequencies are inversly related to classes i.e. as classes increase frequencies decrease.

Figure no. 2.7 shows that more than 83 percent of the total surface area of the entire study region is under very poor category of stream frequency. About 10 percent of the area is under transitional category (very poor to poor). Only 5.13% of the area is under poor

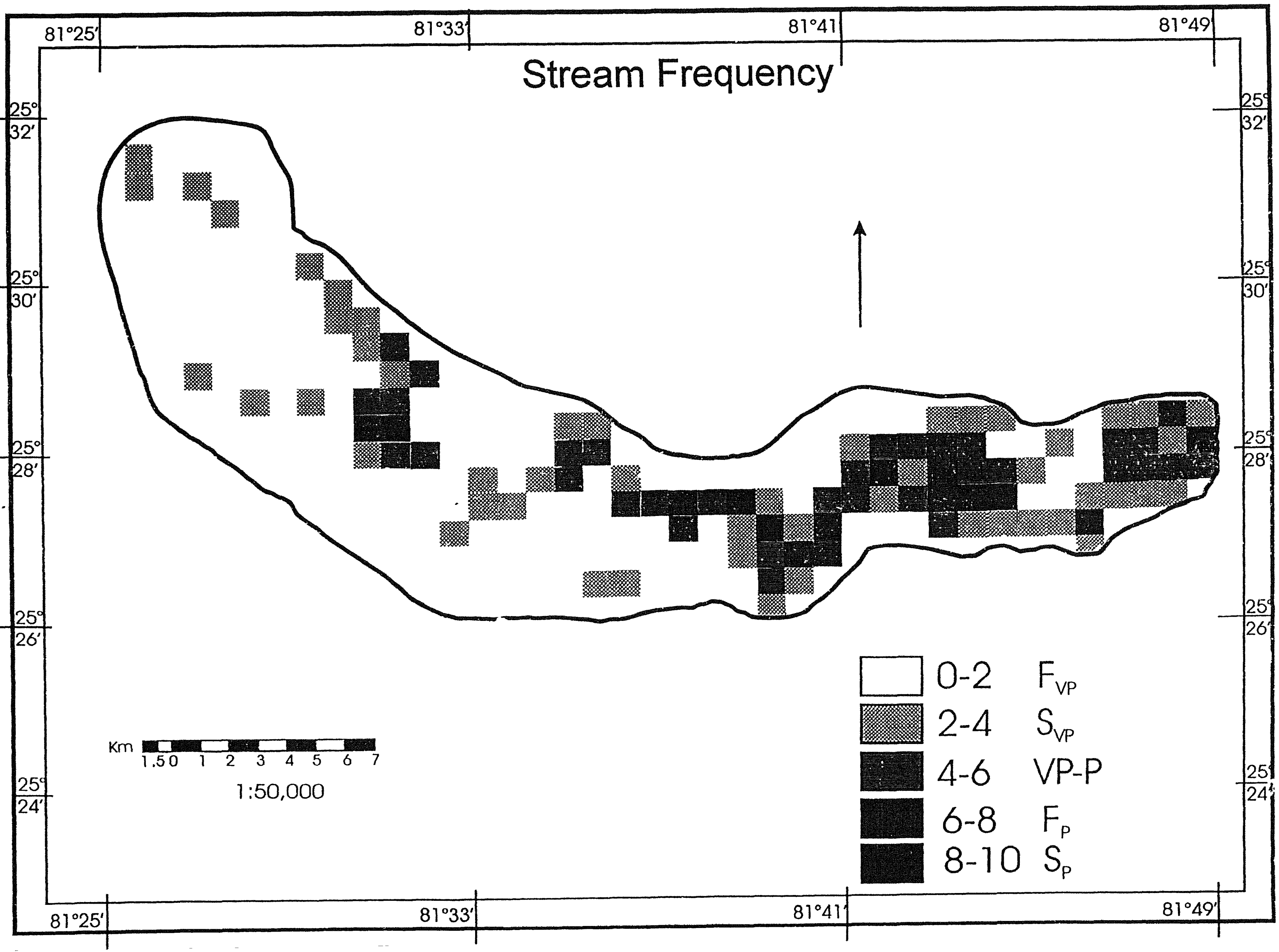

Stream Frequency
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
0-2 F VP
2-4 S VP
4-6 VP-P
6-8 F P
8-10 S P
Km 1.5 0 1 2 3 4 5 6 7
1:50,000

Fig. No 2.7

category of stream frequency. This can be explained in terms of both topographical and lithological character of this basin which is a part of Ganga Yamuna Doab. The high proportion of level area is the most important factor where gullying has resulted due to formation of numerous rills. In order to assess the over – all distribution of stream frequency, the mean, standard deviation, variance, variation and coefficient of variation have been derived and mentioned below Table No. 2.7. It may be pointed out that the choropleth maps showing patterns of stream frequency, drainage density and drainage texture are almost identical with slight difference because all the three variables are related to the stream in one way or the other.

Frequency of each category of the drainage and relief variables viz., Relative Relief, average slope dissection index drainage density, drainage texture and stream frequency, of the basin with their percentage have been shown in table no. 2.2, 2.3, 2.4, 2.5, 2.6 and 2.7 respectively. Frequency polygons, cumulative percentage frequency (O give) cures have been drawn and exhibited in figure no. 2.8

CORRELATION ANALYSIS OFGEOMORPHIC VARIABLESAND INFLUENCING FACTORS

It has been attempted to find out correlation among all morphometric variables for drainage basin analysis. For this purpose coefficients of correlations among all

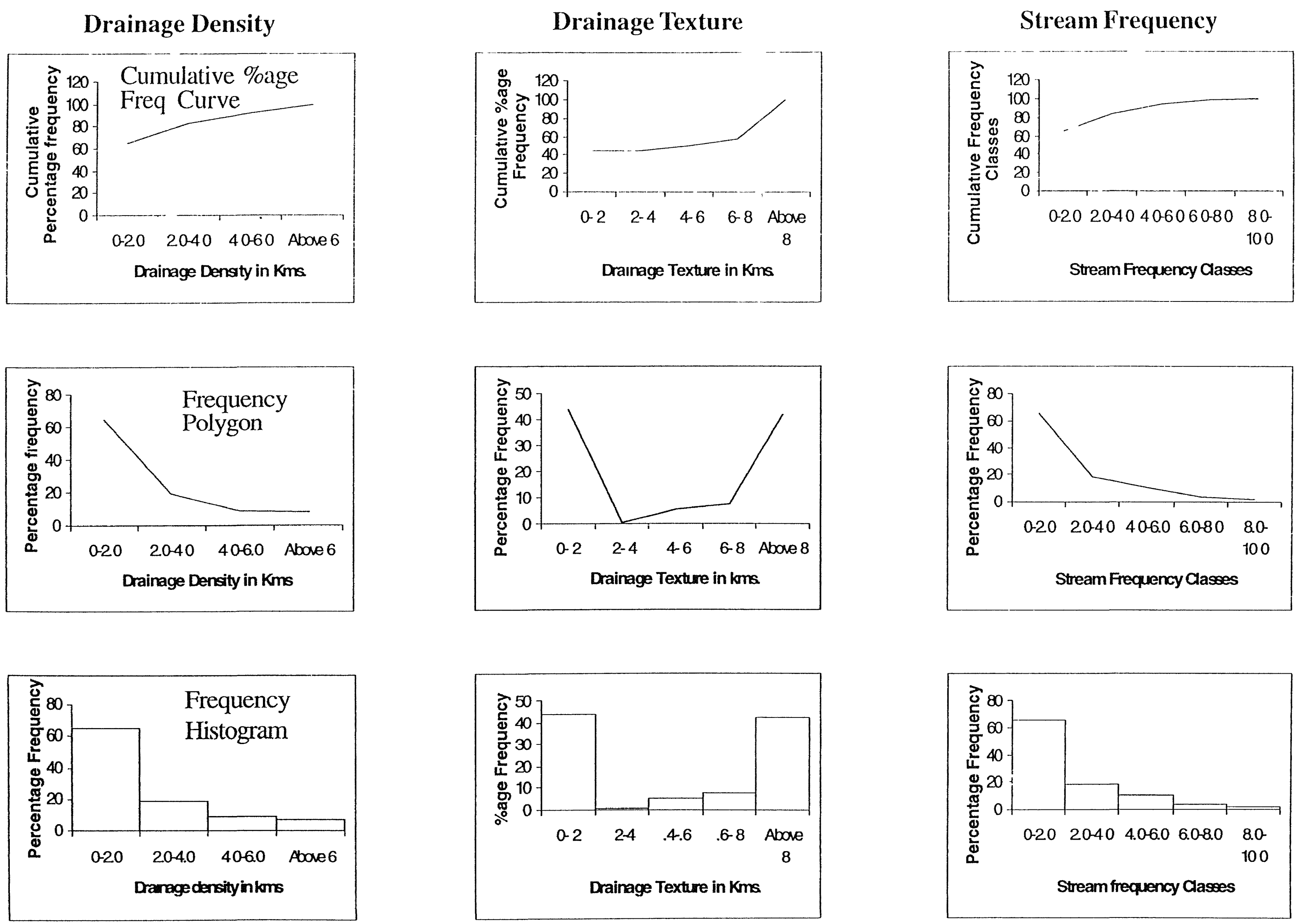
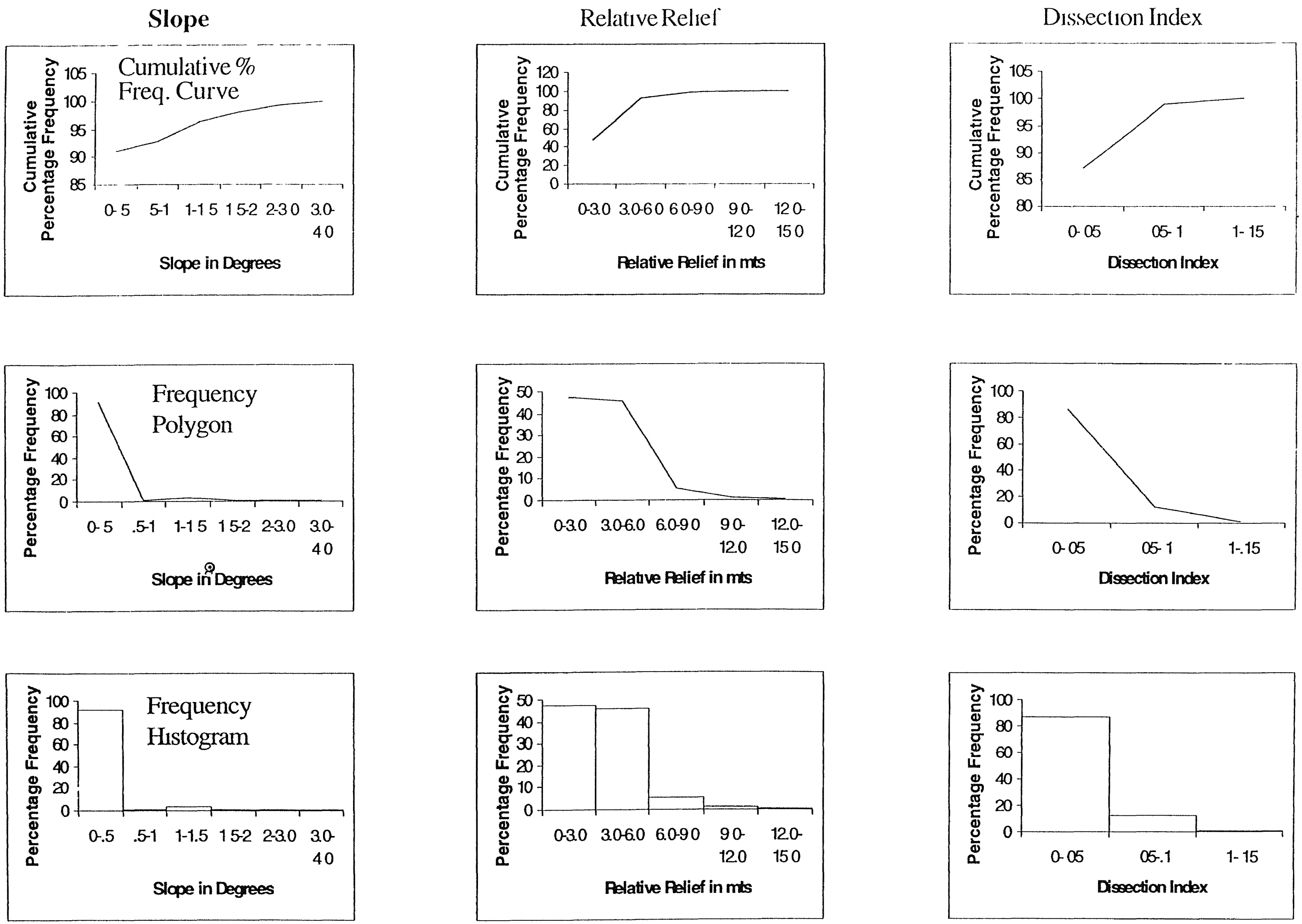

Drainage Density
Drainage Texture
Stream Frequency
Cumulative %age Freq Curve
Cumulative Percentage frequency
120
100
80
60
40
20
0
0-2.0
2.0-4.0
4.0-6.0
Above 6
Drainage Density in Kms.
Cumulative %age Frequency
0-2
2-4
4-6
6-8
Above 8
Drainage Texture in Kms.
Cumulative Frequency Classes
0-2.0
2.0-4.0
4.0-6.0
6.0-8.0
8.0-10.0
Stream Frequency Classes
Frequency Polygon
Percentage frequency
Drainage Density in Kms
Percentage Frequency
50
40
30
10
Drainage Texture in kms.
Frequency Histogram
Drainage density in kms
%age Frequency
.4-6
.6-8
Stream frequency Classes

Fig. no. 2.8 B



Slope
Relative Relief
Dissection Index
Cumulative % Freq. Curve
Frequency Polygon
Frequency Histogram
Cumulative Percentage Frequency
Percentage Frequency
Slope in Degrees
Relative Relief in mts
Dissection Index
0-5 5-1 1-1 5 1 5-2 2-3 0 3.0-4 0
0-3.0 3.0-6 0 6 0-9 0 9 0-12 0 12 0-15 0
0-05 05-1 1-15

Fig. no. 2.8 A

morphometric variables (Dd, Dt, Sf, As, RRand DI) of the basin under study have been computed and the result has been given in Table No-2.8.

Table no. 2.8

CORRELATION MATRIX

	DT	Dd	SF	AS	RR	DI
DT	1.00	.04473	.07308	.04363.	.02709	.02812
Dd	.0447	1.0000.	.89269	.17178	.49320	.49626
SF	.07308	.89269	1.0000	.14860	.42603	.42921
AS	.04363	.17178	.14860	1.0000	.15259	.15444
RR	.02709	.49320	.42603	.15259	1.0000	.99899
DI	.02812	.49626	.42921	.15444	.99899	1.000

In a drainage basin, all the morphometric variables are interrelated. The degree of relationship varies among different morphometric variables. An attempt has been made to study the relationship among morphometric variables to ascertain their mutual interdependence so that their causal relationship may be worked out.

It is apparent from the table no- 2.8 that the derivative of relative relief is positively correlated with average slope which is weak (r = + .15); its correlation with dissection index is (r = + .99) which is considerably high.

In fact, the relative relief and average slope are cause and effect of each other and there is positive relationship between these two

variables. Slope accelerates the rate of fluvial process which resort to rapid rate of vertical erosion and thus causes varing magnitude of relative reliefs. Such observation is valid in the case of only those relative reliefs which are denudation at in genesis and thus slope acts as independent variable affecting the resultant relative relief.

The relationship between relative relief and dissection Index is always positive and therefore self explanatory. This is so because dissection Index is a function of the relative relief and absolute relief. Thus both yield high correlation coefficient (table no- 2.8) and hence this relation does not need any explanation. The impact of relative relief on the drainage variables (drainage density, drainage texture and stream frequency) is of no geomorphological importance in the study region in terrain drainage lines bring about the ruggedness. The relationships among them are not strong. The high relative reliefs are characterised by lesser number of streams, and therefore, low drainage density, very poor stream frequency and coarse drainage texture predominate. Slope is one of the most important causative factors of drainage density, drainage texture and stream frequency. Slope affects the pattern of drainge and obviously it should have some relationship with drainage density and stream frequency. The coefficients of correlation between slope with drainage density and between slope and stream frequency are r = + .17 and r = . 14 respectively. This

result points out that low drainage density is found in the few area of level slope. It means that slope and drainage density are positively related.

Similarly a positive correlation of r = .04 between slope and drainage texture falls in the same situation. It has also been observed in the study region that gentler the slope the coarser is the drainage texture, resulting in the lesser number of stream per unit length. The relationship between slope and stream frequency is also weak (r = .14). This can be explained by the fact that badland topography consisting of rills and gullies in lowlying areas having level to gentle slope produces high stream frequency has been as shown is fig no. 2.6 and 2.2 (stream frequ. And slope map). It is essential to mention here, as has been discussed earlier, that slope is not solely responsible for controlling these morphometric attributes, but also the association of favourable rainfall, vegetation, lithological and geological structure, have their own share in affecting the drainage density, stream, frequency and drainage texture.

Relative relief is affected by drainage density. Some relationship between dissection index and drainage density is also expected. Coefficient of correlation of + .49 found between dissection index and drainage density is significant. Coefficient of correlation existing between dissection index and drainage texture reinforce the conclusions drawn above. The relationship between dissection index and stream frequency is also positively stronger (r = .42) than those of

drainage density and drainage texture. In the study area gullying enhances the number of streams but does not make a comparable change in dissection index.

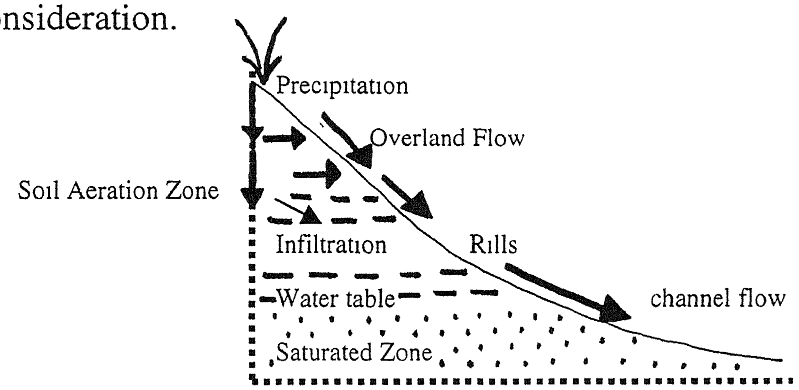
Coefficient of correlation of r = + .04 between drainage density and drainage texture (Table no. 2.8) proves the fact that lower the drainage density and lower the number of streams per unit length in the study area and coarser is the drainage texture. The study of table no. 2.8 concludes that drainage density drainage texture and stream frequency are highly interdependent variables through out the region. Drainage density drainage texture, stream frequency are a~~e~~ffected by slope, structure, lithology, precipitation and vegetation cover. These factors exercise greater control than other environmental factors in the area under study.

CHAPTER 3

HYDROLOGICAL ANALYSIS

The region under study is a part of Ganga Yamuna Doab. It has almost plane surface except some undulating topography. The surface has been found to be built up by a long process mainly of fluvial actions through erosion and sedimentation. It has passed through the various stages of its development since the ancient times. It is marked by zig-zag valley with flow of water (mainly during rainy seasons). It is, therefore, necessary to study the hydrology of the area under study. The water resources may be broadly divided into surface water or run off and the under ground water. It is also important to study the water budget of the atmospheric water so that the mechanism of the geomorphic processes and the morphological features, resulting therefrom, can be analysed and discussed in the succeeding chapters. Soil characteristics and agricultural system of the region are influenced to some extent by under ground water resources. Especially agriculture, at the time of dry period, is mainly carried on with the help of irrigation water from wells, ponds and rivers. But the capability for water supply is mainly dependent on the depth of water table, i.e. the upper surface of ground water. Generally higher the water table, greater is the frequency of surface water in the form of

ponds, tanks and wells. It is significant to point out that the lack of requisite data and inconsistency of available data have altogether forced the present investigator to compute the relevant and required hydrological data on the basis of a few formulae and thus the final picture of hydrology of the study region is based on computed value, where in, the mean annual rainfall, ground water recharge, discharge of water in Sasurkhaderi river, yearly hydrographs, etc. have been taken in to consideration.



Model. Overland flow model based on Horton R. E.

Hydrological Study of the Lower basin

It is very important to study the role of water determining the operation of the geomorphic processes and their morphological features, specially in this particular region where the role of fluvial process is dominant. The region is composed of the alluvi~~al~~um brought down by the river Ganga and Yamuna. Therefore it becomes necessary to study the hydrology of the region. Hydrology is concerned with the study of water in all its forms. Water in form of precipitation on land may pass through the hydrological cycle in many

ways. Basically, there are two main types of supply of water in the drainage basin viz. overland flow and ground water flow. Water that falls as precipitation on land infiltrates into the soil and gradually reaches the ground water table below.

The above model based on Horton shows a form of hydrological cycle which incorporates various processes like precipitation, run-off, infiltration or recharge of the ground water etc. The conveyance of the precipitated water by streams in the form of run off and evaporation of water back to the atmosphere plays an important role in the mechanism of fluvial processes, which has fashioned the morphological features of the area.

In the area under study precipitation exceeds evapo-transpiration in rainy season. The excess water creates water-logging and interferes with successful crop production. There fore, drainage is necessary to increase crop production. Irrigation and drainage have, opposing functions. But the two are related in that the excess of one may accentuate the need for the other. Irrigation from major works leads directly or indirectly to the rise of water table, culminating eventually in water logging and associated problems. Water applied over and above that which is needed to meet the consumptive use of crops, percolates down wards and finds its way to the water table.

In the area on normal soils and with irrigation water of good quality, over irrigation is neither necessary nor desirable but is

unavailable to some extent and is generally excessive on account of inadequate levelling of the field and poor water management practices.

Indeed, in some cases, irrigation efficiency may be as low as fifty percent. In addition to deep percolation, run off and sewage losses from canals, distributaries and water courses contribute to water-logging.

The relative role of irrigation and monsoon rains on the rise of sub soil water has been the subject of considerable investigation. It is found from the depth of water surface in the wells in the area under study that linear relationship existed between the rise of water table from June to October and the rainfall during July to September.

Draining fertile wet cropland is one of the important practices of conservation farming. On many farms, the bottoms have the most fertile soil, but because they are wet during part of the year they produce only part of the yield they could produce. Once drained, they will produce bumper row crops.

Crops planted on land that needs drainage often burn out. In soil that is saturated nearly to the surface in spring and early summer, the plant roots spread out near the surface. Later, when summer droughts come, the water table falls ~~par~~ far below the roots and the crop gets little moisture. In well-drained land, the roots go down deeper.

Thus they can draw moisture from a deeper zone, and the plants with stand summer droughts better.

Excess water can be drained from land either by open surface drains or by under drains usually tile. Each method has advantages and disadvantages. Open ditches occupy land. They are usually hard to cross with farm machinery. They choke up with weeds and silt and have to be cleared. Unless they are deep they drain only the surface, not the soil. For heavy and compact soils in humid areas surface drainage is usually necessary.

Tile drains, on the other hand, waste no land and do not interfere with farm operations. They need little care once they are installed. Since they drain the pores of the soil, roots of crops can spread. But tile drains require more cash outlay in the beginning, and are not effective in some soils.

The possibility of utilizing the drained water irrigation, by pumping, if necessary, should also be explored. Since the low lying areas of farm are likely to remain wet during the rainy season, they should best be utilized by growing a crop like paddy which can stand water logging. If natural drainage is not sufficient artificial drain as should be started.

The water shed of the study region is spread over an area of 30100 sq km. The catchment area in the reach of the lower Sasurkhaderi river is almost plain with extremely small area of forest

of deciduous type which is quite unable to prevent the intensity and volume of surface run off. The level with gentle slope (table no. 2.3) of the area and low drainage density (table no. 2.5) indicate the fact that the surface run off of the river in this section is quite high.

The study region of the Kaushambi district gets atmospheric water in the form of rainfall through condensation. The rainfall data of the Sasurkhaderi river basin have been collected from the three rain gauge stations located in the study region which are maintained by the Allahabad Meteorological observatory, Bamrauly. On the basis of collected data average annual rainfall of 97.5 cm (38.40''), which when multiplied by the total area of the study region (301 sq km), gives the total amount of the atmospheric water as 29347.5 lac~~k~~ cubic metres. Surface run-off is that part of the rain water which remains at the surface of the earth as surplus water which flows over the ground surface to lower levels and ultimately collects into streams and is involved in weathering and erosion. Weathering and erosion affect and determine the topographic features of the study region.

In hydrology the study of ground water is very important and therefore, the study of ground water table is necessary.

GROUND WATER STUDY AND STUDY OF WATER RESOURCE

The largest available source of fresh water lies under ground. Ground water hydrology is defined as the science of the occurrence, distribution and movement of water below the surface of the earth. Geohydrology and hydrology both indicate the same meaning. Hydrogeology differs from the aforcsaid terms only by its greater emphasis on geology. Ground water is being utilized from days forlorn, yet understanding and study of the occurrence and movement of subsurface water as part of the hydrologic cycle has relatively gained importance recently.

Ground water without further reference or specification is generally supposed to mean water occupying the empty space or voids within subsurface stratum. The water filled zone is to be distinguished from an unsaturated or aeration zone where voids are filled with water and air. Saturated zones containing water is important for engineering works, geologic studies and water supply development. Unsaturated zones are found above saturated zones and extend upward to the ground surface.

Ground water development is traceable from ancient times. The increase in population of man and animal increased the utilization of ground water more and more. Its utilization greatly preceded understanding of its origin, occurrence and movement. Greek and

Roman philosophers put forward various theories to explain the origins of ground water which ranged from phantasy to almost scientific truth. As far as 19th century it was that rainfall was not the source of water coming out from springs because upto that time it was thought that earth was not pervious enough to absorb rain water below the surface. Early Greek philosophers like Homer, Thales and Plato supposed that sea, water carried and purified through underground, was the source of springs. Aristotle opined that air enters the cold dark hollows under the mountains where it condenses into water and becomes the source of springs. The Roman thinkers such as Seneca nd Pliny simply followed the Greek ideas and contributed nothing anew. It was the Roman architect Vitruvious, who advanced a step forward nearer to the truth, explained that mountains receive large amount of rain that percolate through the rock strata and cause to form streams below the sub surface. This was the origin of the infiltration theory which has been accepted presently.

The Greek theories remained to dominate through the Middle age with no advances. The French Botter and philosopher Bernard Palissy (1510-1589) but forth his ideas which combined the infiltration sea water theory of and the vaporization and condensation processes within the earth.

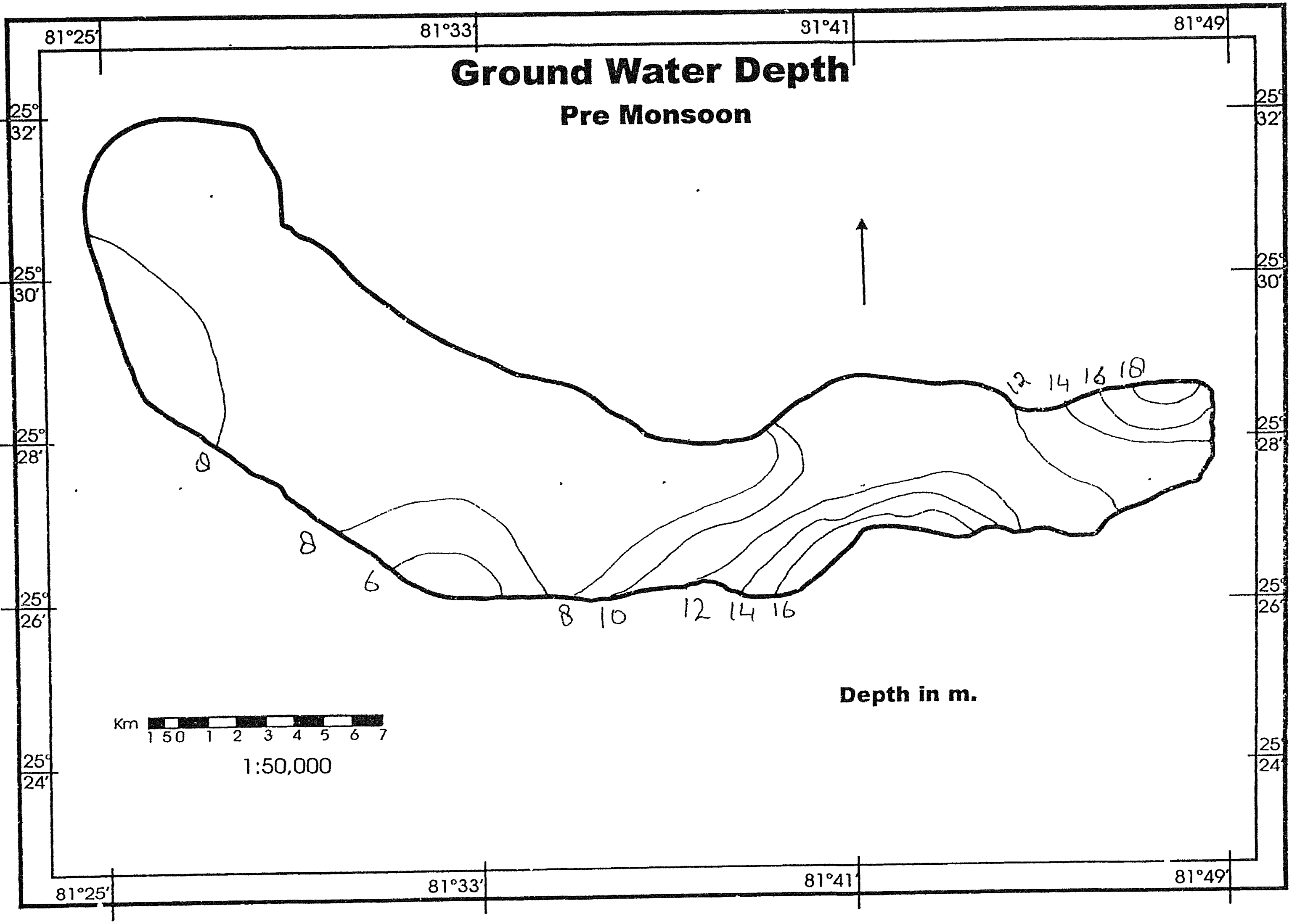
It was in the latter part of the 17th century that a clear concept of hydrologic cycle emerged. For the first time theories were based on

observation and quantitative data. Fundamentals in geology were, however, established during the 18th century that made available a basis for understanding the cause, happening and movement of ground water. The drilling of many artesian wells during the first half of the nineteenth century encouraged interest in ground water. Henry Darchy (1803-1858) the French hydraulic engineer studied the movement of water through sand. His writings of 1856 defined the relation, now known as Darcy's law governing ground water flow in most alluvial and sedimentary formations. Later European works on the subject in the 19th century dwelt on the hydraulics of ground water development. The twentieth century has witnessed the all round increased activity in different phases of ground water hydrology and a number of publications on the subject has come into existence. (R Dachler, E Imbeaux, K. Kelhach, W Kochne J kozeny, E Prinz, H. Schoeller and G Tehicm are best known in U.S.A.)

Through out the world under ground water is an important source of water supply. Its utilization for rural homes, municipalities, industrics and irrigation is progressively increasing. India is one of the largest populated country in the world and percent of its population reside in villages. Ground water from single dug well is the only water source in many of the Indian villages. Cooling and air conditioning have made heavy demands on ground water because of its uniformity in temperature. Shortages of ground water in areas of many Indian

villages, where excessive with drawls have been done, emphasize the need for accurate estimates of the available underground resources and the importance of proper planning to ensure the continued water supplies.

Soil and agriculture characteristics of a region are influenced by ground water resources. Agriculture is mainly carried on with the help of irrigation from wells, tub-wells, ponds and rivers but the capacity for water supply is mainly dependent on the depth of water table, i.e. the upper surface of ground water. The depth of water table exercises a control on agricultural pursuits. The ground water fluctuates from June to October due to rainfall variation in the study region. In particular the seasonal fluctuations of the ground water table are in a large measure responsible for the different soil types of the region which is turn result in varying agricultural development of the region. The data of the observations of ground water tables have been collected from the central ground water board, Allahabad U.P. and the contours (pre monsoon and post monsoon periods) for the water tables have been drawn (fig no. 3.1 and fig no. 3.2) indicates. It is very interesting to note that the net rise in the ground water tables at different stations from pre monsoon to post monsoon season is not only positive at all stations but there is perfect relationship between the pre monsoon depth and net rising during post monsoon season (table-3.1). The rise the ground water table from pre monsoon to post



Ground Water Depth
Pre Monsoon
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
8
8
6
8
10
12
14
16
12
14
16
18
Depth in m.
Km
1 50 1 2 3 4 5 6 7
1:50,000

Fig No 3.1

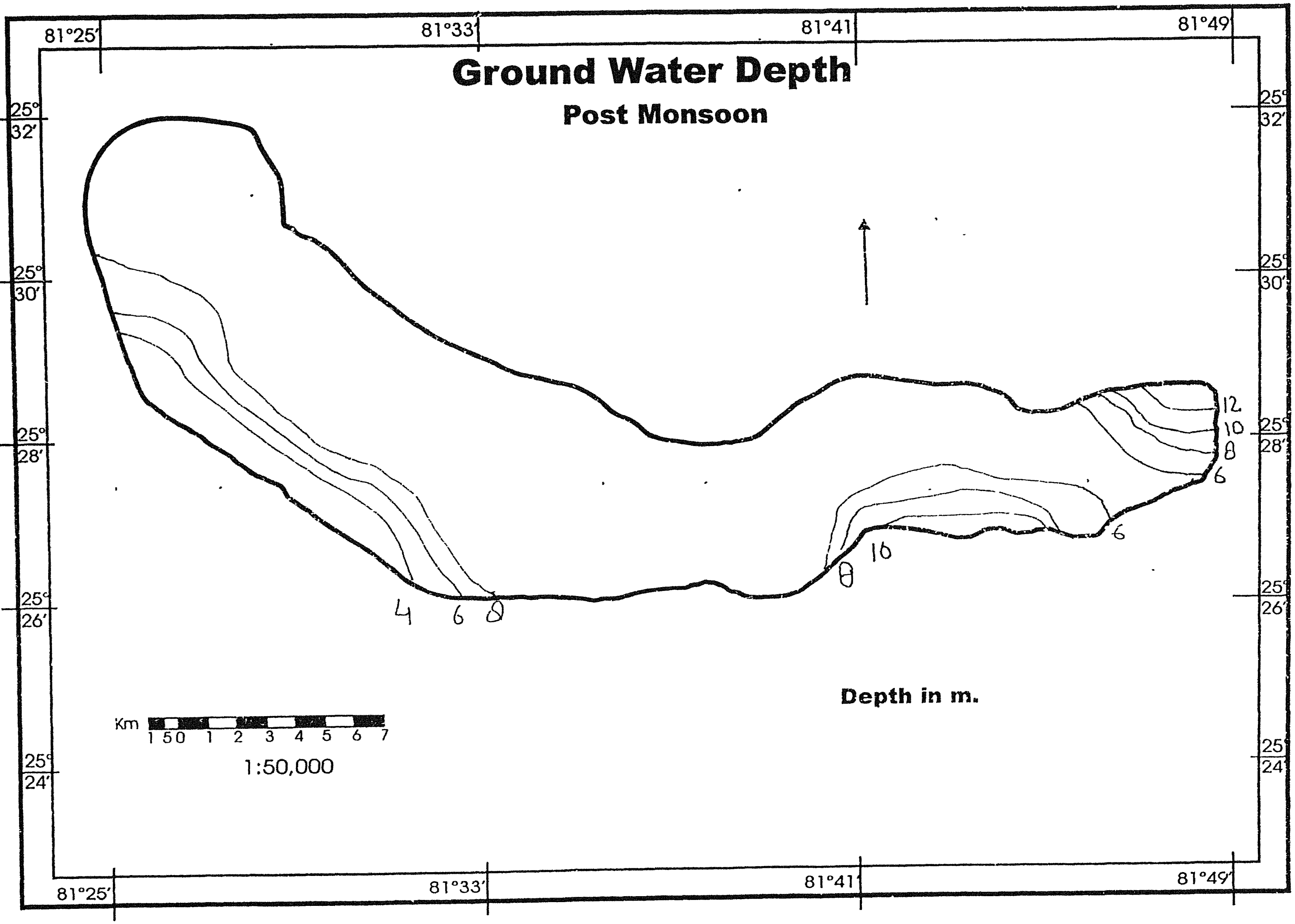

Ground Water Depth
Post Monsoon
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
12
10
8
6
16
4
Depth in m.
Km 1 50 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 3.2

monsoon season is because of infiltration of a part of rain water during the rainy months.

Table No-3.1

DEPTH TO WATER LEVELS

IN (m.) (b.g.l.)

BLOCK	Year	May	Nov
CHAIL Khas	1998	14.81	14.77
Well No. 10	1999	-	13.13
Location	2000	N.D	11.22
Sallahpur			
Chail	1998	20.64	17.80
Well No. 26	1999	19.21	3.95
Location	2000	18.16	17.59
Mandari			
Newada	1998	16.55	15.40
Well No. 50	1999	16.55	10.96
Location	2000	12.45	11.40
Perai			
Muratganj	1998	-	-
Well No. 37	1999	-	-

Location	2000	-	-
Mugersan			
Newada	1998	9.67	7
Well No. 120	1999	6.55	2.25
Location	2000	N.D.	5
Sarai Akil			
Manjhanpur	1998	7.46	4.64
Well No. 47A	1999	6.59	0.95
Location	2000	5.20	N.D.
Usaryaura			

CHAPTER- IV

GENESIS, PROCESSES AND CLASSIFICATION OF SOIL

Soil is essential for life on earth. Sunshine, oxygen water and food are the basic requirements for existence of life. Food which is one of the bare necesseties is nothing but a result of bounties of nature and soil plays the vital role in the manifestation of the bountics of nature. Thus soil is one of the essential natural resources for the sustenance of life on earth. Agriculture is wholly dependent on soil. In a country like India more than 70% of the population earn their livelihood directly or indirectly from agriculture. Thus importance of soil needs no emphasis.

Soil is that part of the regolith that supports rooted plants [Chester R longwell and Richard F Flint]. It is humus i.e. decomposed rock debris and decayed organic matter produced by weathering. From agricultural point of view the distribution and density of population are always in conformity with the evolving and persisting pattern of soil fertility and productivity.

Plants like every living being require food oxygen and sun shine for growth and survival. There is a good chance of rapid growth and maturity if they are well fed. With good nutrition they tend to gather strength enough to resist the insects and diseases which are injurious for growth.

There have been a number of attempts to define soil but Joffe's (1949) definition has been widely used. He defines soil as "a natural body of animal mineral and organic constituent differentiated into horizons of variable depth which differ from the material below in morphology, physical make up, chemical properties and biological characteristics.." According to Thornbury soils are the result of biochemical and physical processes operating upon earth materials under various topographic and climatic conditions. They reflect as much as do land forms the climatic and geomorphic history of the region in which they are evolved.

The present study is based on field work and laboratery analysis of soil samples collected from both irrigated and unirrigated fields located in the lower river basin of Sasur-khaderi. The entire area under study has been divided into units and samples from each unit have been collected. From Fig no.4.1 soil sampelling sites the physical and chemical propertics of the 27 soil samples of the region have been systematically analysed. The result of the analyses are given in the Table no. 4.1 & Table no. 4.2.

Physical properties

The texture of soil depends on the proportions of separate particles of sand, silt and clay. Every sample of soil contains these three ingredients. These three terms within a sample are used to distinguish the coarse, the finer and the finest size fractions

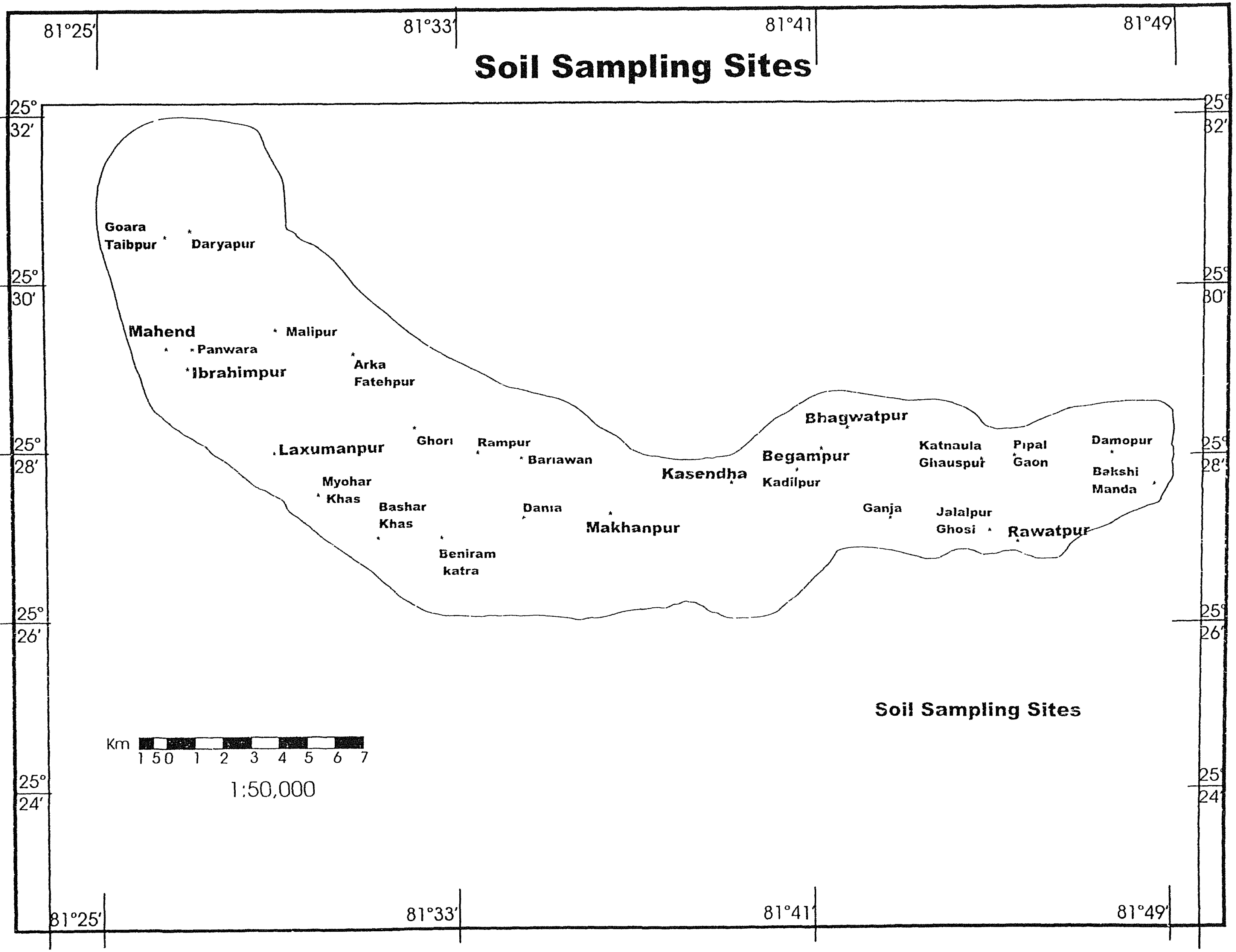

81°25'
81°33'
81°41'
81°49'
Soil Sampling Sites
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
Goara
Taibpur
Daryapur
Mahend
Panwara
Ibrahimpur
Malipur
Arka
Fatehpur
Laxumanpur
Myohar
Khas
Bashar
Khas
Ghori
Rampur
Bariawan
Beniram
katra
Dania
Makhanpur
Kasendha
Begampur
Kadilpur
Bhagwatpur
Ganja
Katnaula
Ghauspur
Jalalpur
Ghosi
Pipal
Gaon
Rawatpur
Damopur
Bakshi
Manda
Soil Sampling Sites
Km
1 5 0 1 2 3 4 5 6 7
1:50,000

Fig. No 4 1

respectively. Whether a soil is heavy (clayey) or light (sandy) is the result of its texture. The use of soil for various purposes depends on its physical properties i.e. the size, shape arrangements of its particles, the forms of its pores, the effective depth of soil from which crops, vegetation and plants obtain nutrition for growth and survival. The porosity and permeability of the soil depends on its physical property. About one half of the volume of soil includes individual particles of stone, gravel, sand, silt and clay. The vacant space or void between the particles is called porosity and is occupied by water and air. The appropriate distribution of capillary and non capillary i.e. fine and large pore space plays a vital role for proper physical conditions of soils for moisture retentive capacity and for plant growth by regulating root aeration. The above discussion shows that soil management requires knowledge and a minute observation of texture, colour, effective depth, structure, permeability, moisture holding capacity, surface drainage slope and erosion.

The knowledge of the physical properties of the soil is essential for the purpose of characterizing the soil and more particularly in respect of determination of suitability for agriculture in the area under study. Texture is of primary importance to know the ability of soil to resist water and wind erosion.

SAND CONTENT: A large amount of sand in a soil will make it coarse and gritty. Such soil is light and may be called

sandy loam, these are well aerated and absorb water readily. Organic matters improve the capacity of sands to hold water. Table No.4.3 Indicates that the percentage of sand is high in the surface of soil of area under study.

Table No.4.3

SAND CONTENT

Category	Percentage	Frequency of Occurrence	Percentage of Occurrence
Low	below 20	1	3.7
Medium	20-30	2	7.4
High	above 30	24	88.9

According to the variation of the sand content in the area under study the soil have been grouped in three broad categories which is shown in table no.4.3 and fig. No. 4.2.

LOW SANDY AREA: The table no.4.3 Indicates that low sandy area is concentrated in 3.7 percent of the total occurrences, which have below 20 percent sand particles.

MEDIUM SANDY AREA: Only two patches of medium sandy soil areas are found in the study region. In this category soils have sand particles between 20 and 30 percent. The medium sandy area is 7.4 percent cent of total occurrence (Fig no.4.2)

HIGH SANDY AREA: The high sandy area is concentrated in 88.9 percent of the total occurrences. Fig no.4.2 show that

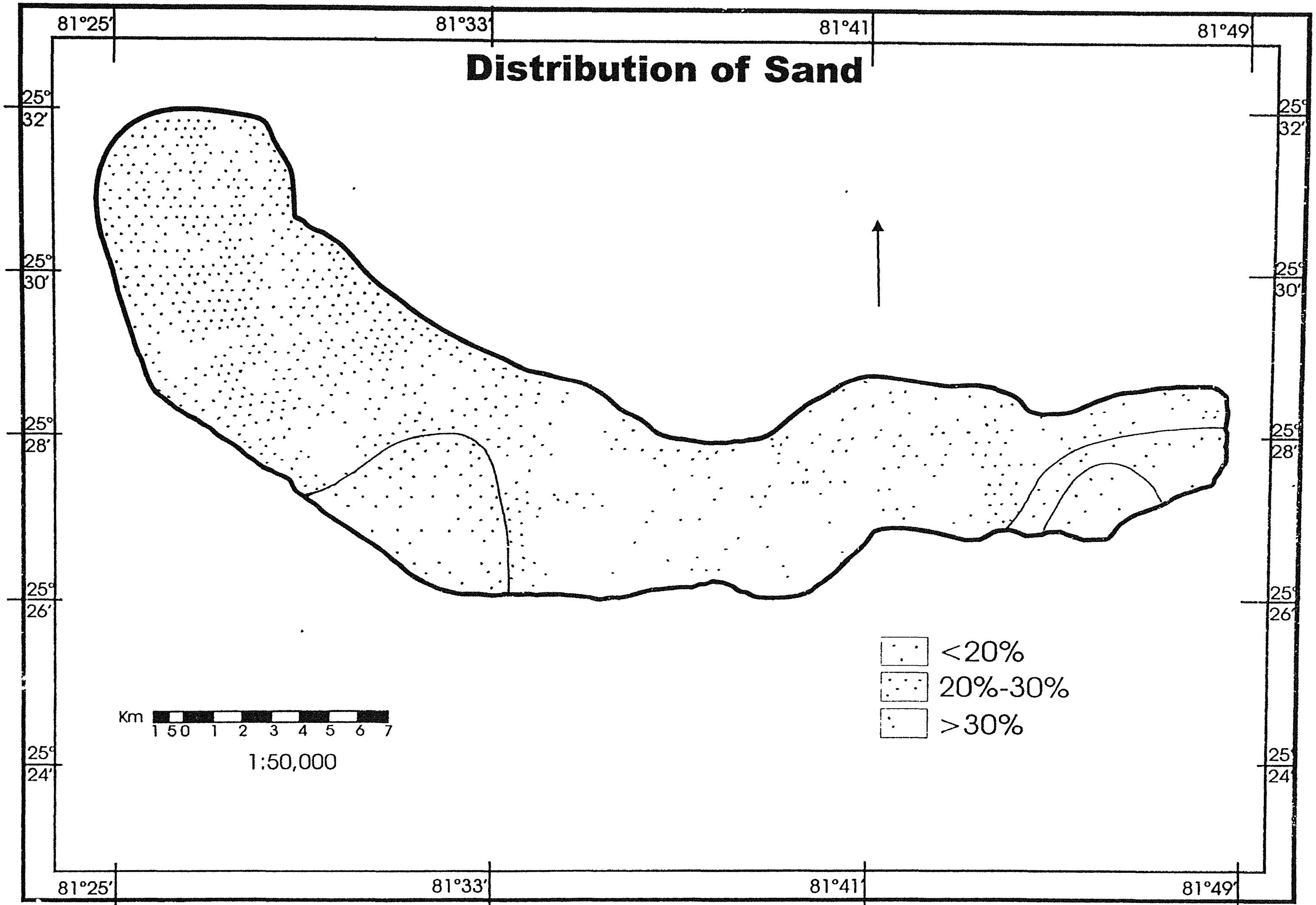

Distribution of Sand
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
<20%
20%-30%
>30%
Km
1 5 0 1 2 3 4 5 6 7
1:50,000

Fig No 4.2

maximum part of region falls under this category. High sandy soils of the region indicate the result of river action. It is important to mention here that the study region is a part of Doab of river Ganga and Yamuna which bring heavy amount of silt and deposit them in the entire Doab.

SILT CONTENT: The percentage of silt in the area under study is medium. About 81.5% part of the total region have medium silt content. According to the variation of the silt content in the area under study the soils have been grouped in three categories which are shown in table no.4.4 and figure no. 4.3.

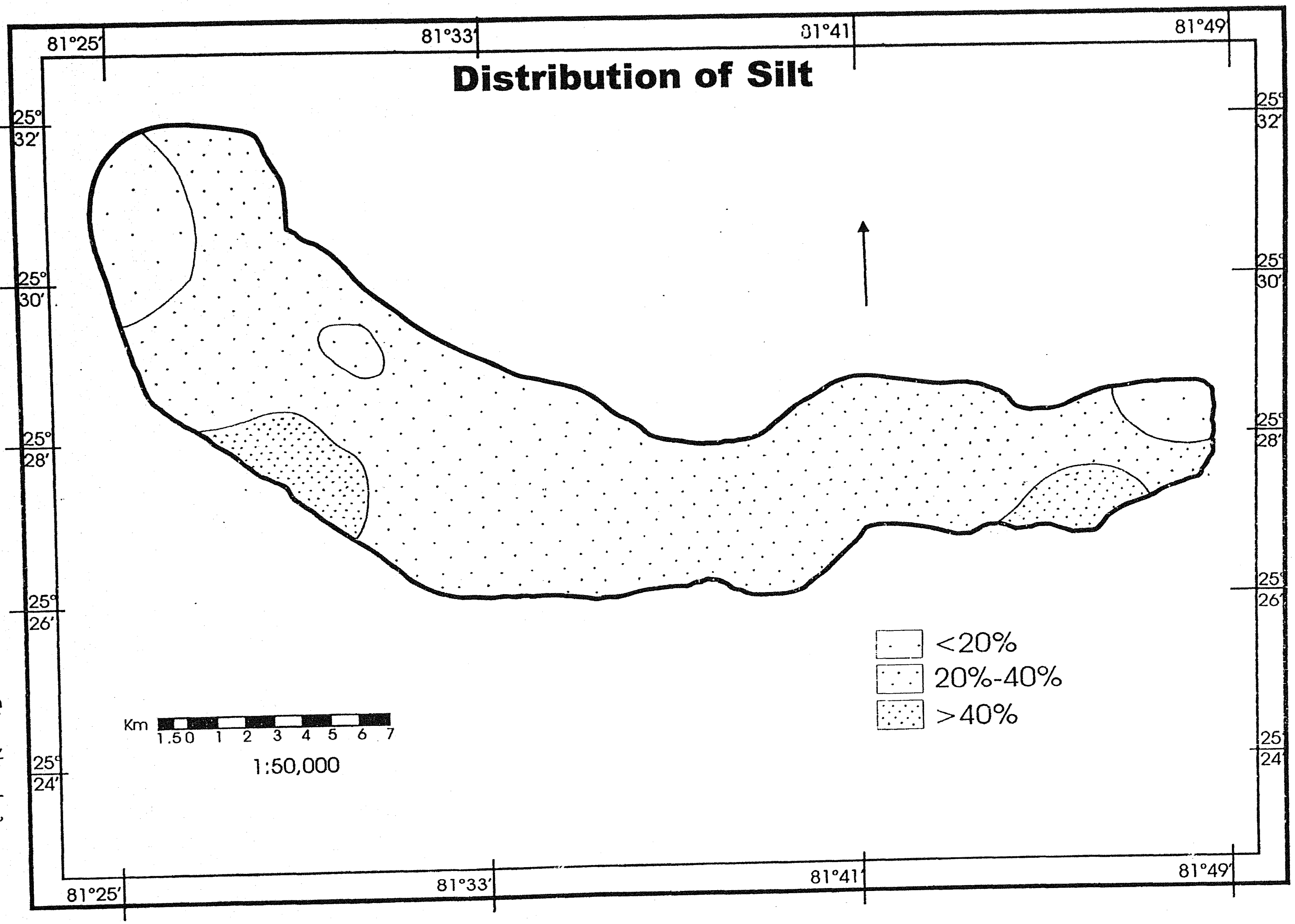
Table No. 4.4

SILT CONTENT

Category	Percentage	Frequency of Occurrence	Percentage of Occurrence
Low	Below 20%	3	11.1
Medium	20-40%	22	81.5
High	Above 40%	2	7.4

LOW SILT CONTENT AREA: This category is found only in 11.1 percent of total occurrence. The percentage of silt in these areas is below 20 percent.

MEDIUM SILT CONTENT AREA: The table no.4.4 shows that 81.5 percent of the total area is under medium silt content area. The amount of silt in this category is about 20 to 40 percent.



Distribution of Silt
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
<20%
20%-40%
>40%
Km 1.5 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 4.3

HIGH SILT CONTENT AREA: This category is found in only 7.4 percent of the total area.(fig no.4.3) High silt content area has above 40 percent silt content in the soil.

Table no.4.5

SILT CONTENT

Category	Percentage	Frequency of Occurrence	Percentage of Occurrence
Low	Below- 25%	7	25.93
Medium	25-30	13	48.14
High	Above 30%	7	25.93

The presence of clay in soil makes it sticky when wet and hard when dry. Such soil is heavy. Clay has the capacity to hold plant nutrients. If there is a good aggregation with large connecting pores for aerations soils with very high clay content may be highly productive. But if aggregation is poor and the pore spaces are tiny and filled with water, the soil may be unproductive because of poor aeration. Generally the amount of clay varies from 25% to 30% within the area under study. According to the variation of the clay content in the soil, the soils of the region have been classified into three groups in the table.no.4.5

LOW CLAY CONTENT AREA: This category is found is 25.93 percent area of total occurrences. Here the percentage of clay content in soil is below 25.

MEDIUM CLAY CONTENT AREA: This category belongs to 48.14 percent area of total occurrences. Here soils have clay content varying from 25% to 30%.

HIGH CLAY CONTENT AREA: The high clay content area belongs to 25.93 percent area of the total area under study.(fig.no.4.4) The soil of the area under this category has clay content about 30 percent.

Various factors influence the formation of soils. These are rock, relief, vegetation, climate and time. The distinguishing features of the soil types in a particular area are based on the nature of surface morphology and the hydrological character. Thus the texture, colour and reaction of the soil are the results of the action and reaction of these factors. Rocks are the mass of minerals. These mineral matters are gradually broken up by weathering. Fragmentation of rocks and minerals are caused by erosion. During the process of fragmentation and erosion certain minerals disappear. Finally, secondary products like clay minerals come into existence. Thus the chemical properties of soil depend not only on the chemical reaction involved in the mode of formation of the soil but also on the chemical composition of the parent rock itself.

CHEMICAL PROPERTIESOF SOIL

ORGANIC MATTER (CARBON CONTENT) IN THE SOIL: Soil organic matter is the matter of plant and animal origin and

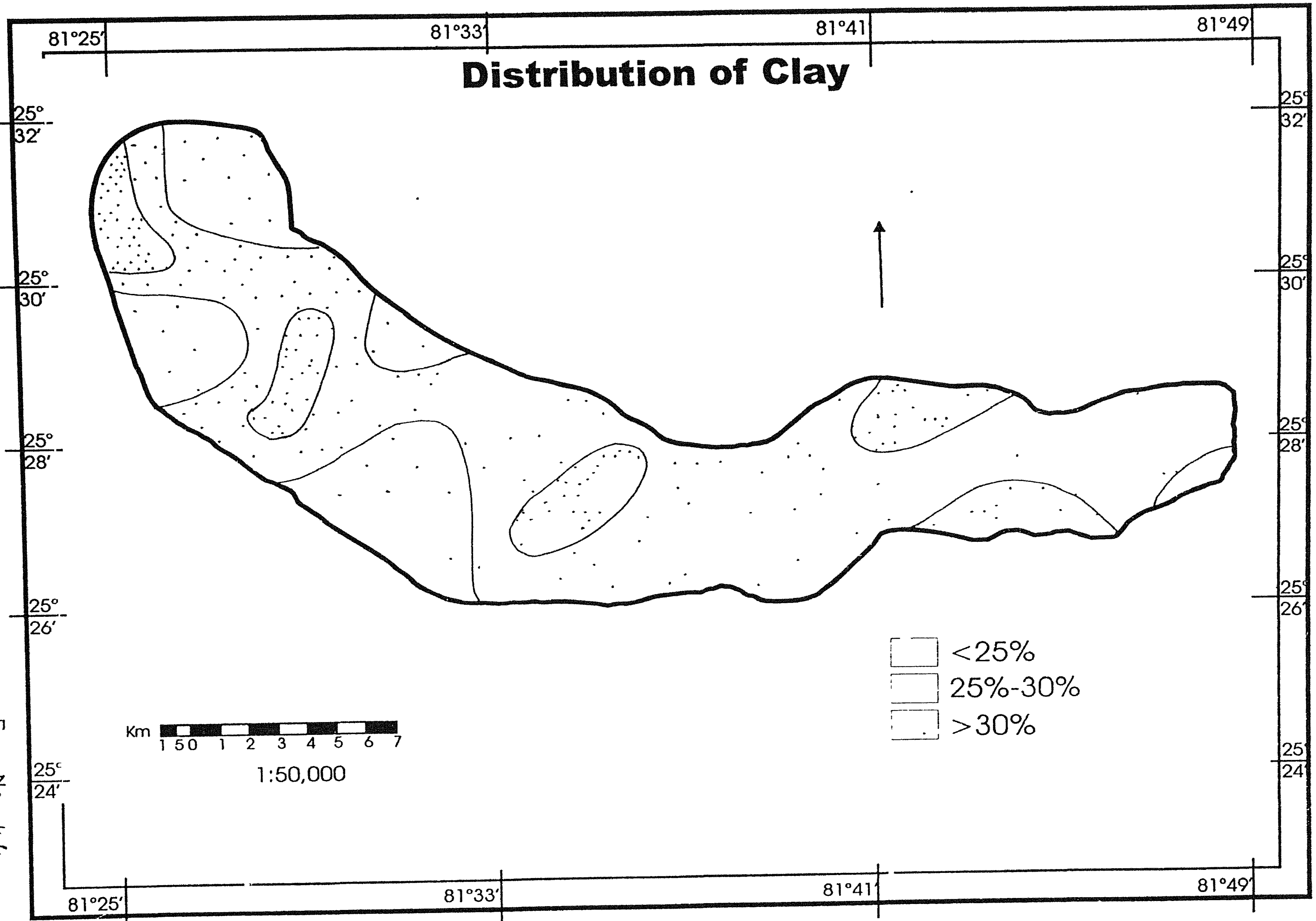

81°25'
81°33'
81°41'
81°49'
Distribution of Clay
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
<25%
25%-30%
>30%
Km
1 5 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 4.4

influences physical and chemical properties of the soil. It commonly accounts for at least half the cation exchange capacity of soil. Plant tissue is the original source of the soil organic matter. Leaves fallen from trees and plants, root, if trees, shrubs, grasses and other native plants perennially supply under natural conditions large quantities of organic residues. The residues of higher plants provide an excellent source of food for micro organism. Soon after residues are left in the soil, the micro organism starts decomposing the material as a source of nutrient and energy. The secondary sources of organic matter are supplied by animals who attack the original plant tissues, contribute waste product. Certain forms of animal life particularly the earth worm, centipedes, and ants also play a vital role in the translocation of plant residues which are the chief source of soil organic matter. The oxidization of carbon constituent of the organic matter is main source of energy for the vegetation world. Oxidization is a continuous process and involves a substantial portion. The various changes that this element undergoes within and without the soil are collectively called carbon cycle. But no convincing method has so far been known for determining organic constituent of soils. Percentage of carbon roughly points out the proportion of organic matter involved in the soil. It is the presence of organic matter which helps the seepage of water gently in to the soil and increases its moisture retentive capacity. Even scanty presence of organic matter makes a lot of

difference in the fertility of the soil. In sandy soils organic colloids assume particular importance. Sandy soils can not be improved by addition of clay. But the addition of organic matter improves the retention capacity of soil moisture and nutrients for a short duration.

Although the area under study is partly covered with social forestry during the period of survey, the humus content of the soil is very low in percentage. Due to high temperature and heavy rainfall during the certain parts of the year, the oxidative decomposition takes place quickly and only a very small part of the plant residue is added to the soil as humus. The latter gets immediately mixed up with the clay fraction of the soil giving rise to clay humus complex. The quantity of organic matter present in the area is low.

NITROGEN CONTENT OF THE SOIL:- The decayed or decaying plant animal materials including microbes, all of which are grouped together under organic matter, are the source of the bulk of the nitrogen supply. The genesis of organic matter is the plant roots left in the soil, the remnants of upper parts of the plants, animal manures or composts applied to the soil and the remains of the animals residing there under. The soil, besides nitrogen of the organic matter, contains little quantities of nitrogen in the inorganic form, manily nitrates and ammonical compounds. The quantities of organic and in organic nitrogen present in the soil differs from soil to soil.

The distribution of nitrogen in the area under study Fig no. 4.5 discloses that the percentage of nitrogen is not high. The amount of carbon present in the soil ranges between 0.017% to 0.075%. This amount is not sufficient for the retention of soil moisture in these areas. According to the variation of nitrogen contents in the soil through out the region the soils of the area may be divided into four classes as shown in the table no.4.6

Table No- 4.6

Sl No.	Classes	Percentage of nitrogen content	Frequency	Percentage of frequency
1.	Extremely low	00-0.02	2	7.40
2.	Low	0.02-0.04	3	11.11
3.	Medium	0.04-0.06	14	51.85
4.	High	0.06-0.075	8	29.62

EXTREMELY LOW NITROGEN CONTENT AREA : This group covers 7.4 percent of the total area under study as shown in the table. The carbon content in soil varies between 0-.02 percent in this area under consideration, which along with other villages includes village kathaula Ghauspur and village Pipalgaon.

LOW NITROGEN CONTENT AREA : This category spread over 11.11 per cent of the total area under study. Some of the main villages are Malipur, Arka Fatehpur, and Makhanpur in the area

under consideration where carbon content in the soil varies between 0.02-0.04 percent.

MEDIUM NITROGEN CONTENT AREA : This group is concentrated in 51.85 per cent of the area of total occurrences. In most of the soils of western part of the region except those in the extreme western border of the area and some other patches, carbon content varies between 0.04-0.06 percent.

HIGH NITROGEN CONTENT : This groups belongs to 29.62 per cent of the area of the total occurrence. Soils having comparatively good amount of carbon are found in five small patches of the study region. These are located in Goara Taiyabpur, Mahend, Basohar Khas, Dan_ia, Kadipur, Ganja and Bhagwatpur villages carbon content varies between .06 to .075 percent.

The distribution of nitrogen in the area under consideration depicts that it has decreasing trend from west to east. Nitrogen contents in soils have a closer relationship with forest growth. There is no forest worth the name in the area under study. Only social forest_ry can be seen here and there, particularly along the road sides. Garden and orchards can also be seen in area.

PHOSPHATE CONTENTS OF THE SOIL : The every living cell in a plant contains phosphorus which plays an important role in every activity of growth, respiration and reproduction. No crop can grow with the scant supply of phosphorus in the seed unless more

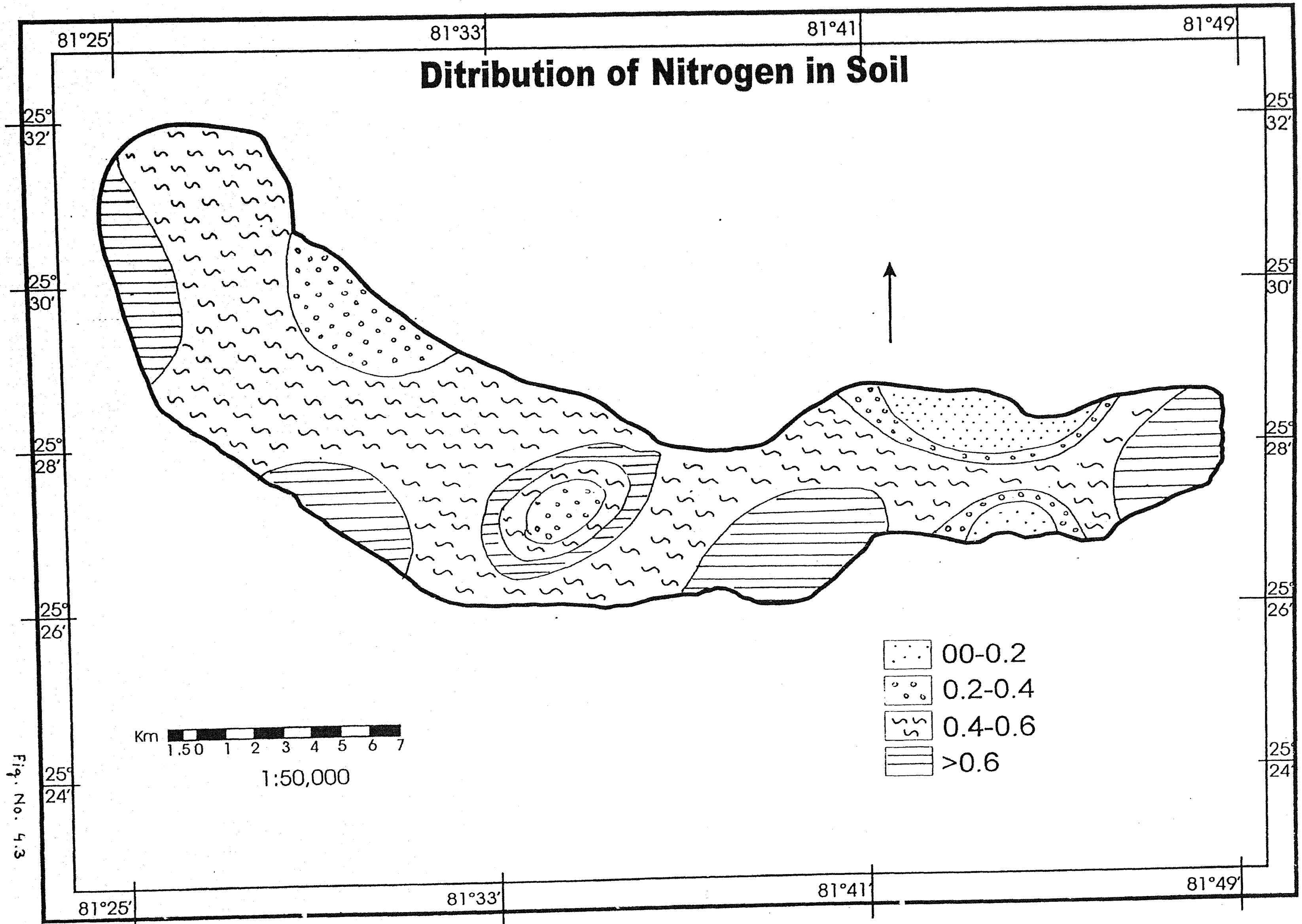

Ditribution of Nitrogen in Soil
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
00-0.2
0.2-0.4
0.4-0.6
>0.6
Km
1.5 0 1 2 3 4 5 6 7
1:50,000

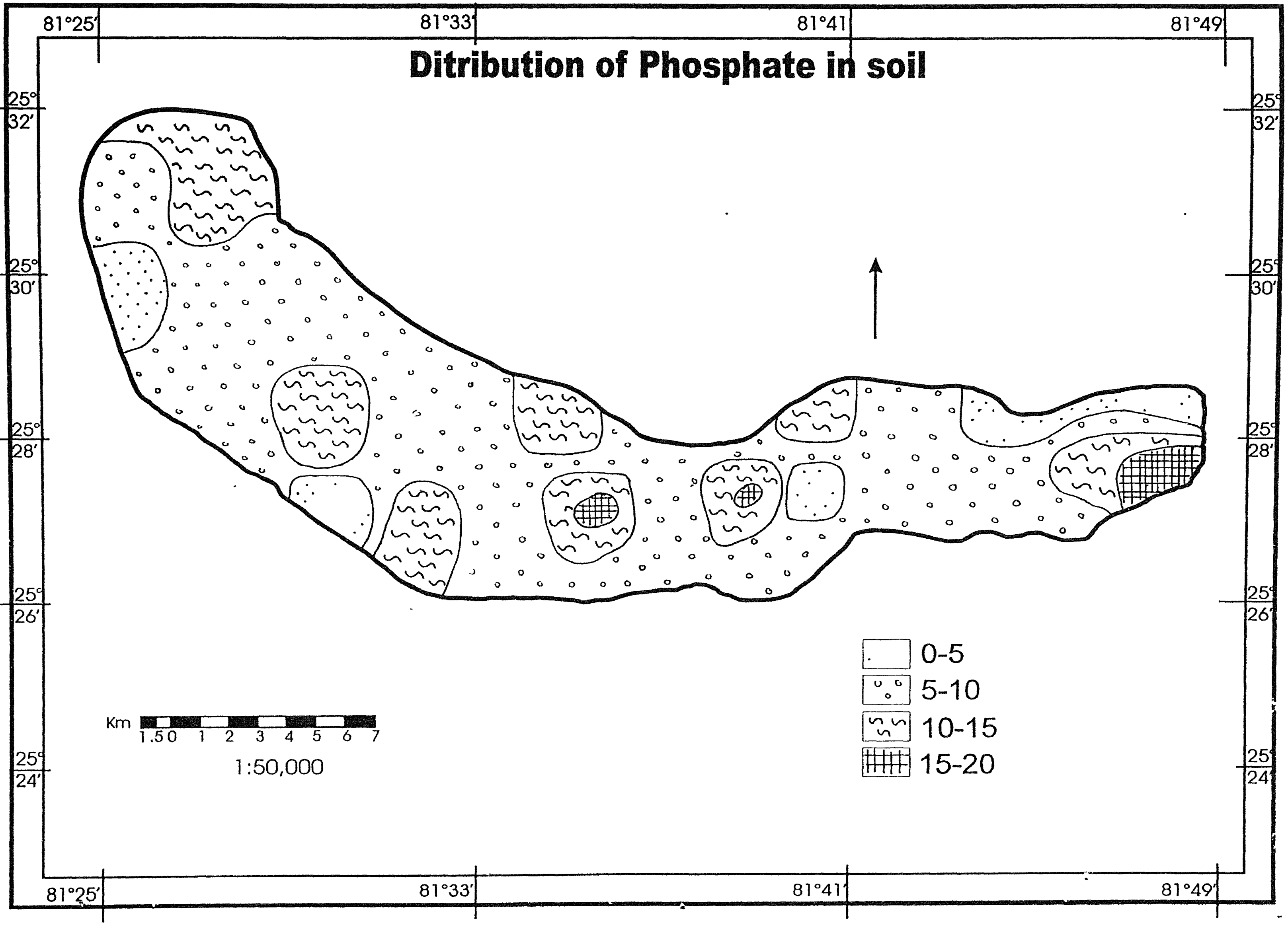
Fig. No. 4.3

becomes available from the soil. Lack of adequate phosphorus retards the normal growth, blossoming, yields of fruit and grains.

Plants must get their phosphorus from the soil solution. But test of the soil solution has shown that there is very little phosphate there at any one time. This means that there must be certain amount of phosphorus in the soil in a form that will go into the soil water readily. Most fertilisers contain the soluble phosphorus form and that is why they are so effective. It is important also that the total supply of soil phosphorus be built up so that the unavailable form of phosphate will convert to the available state at a steady rate. Another characteristic of soil phosphorus is that it does not move readily in the soil. This means that the roots must move to the phosphorus. It is therefore, important that poor soil structure does not hamper root growth. It has also been found that manure and crop residues tend to reduce the fixation of phosphorus in soil.

PHOSPHATE STATUS IN SOILS OF THE REGION- Generally, the phosphate content of the major part of the region is extremely low.(fig.no. 4.6) But some parts of the region have low phosphate content in the soil. It is convenient to describe the distribution of phosphate within the region into three classes.

EXTREMELY LOW PHOSPHATE CONTENT AREA- This group is found in 22.22 percent of the total occurances. Soil of Mahend, Myohar Khas, Kadilpur, Kathaula Ghauspur, Pipalgoun and



Ditribution of Phosphate in soil
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
0-5
5-10
10-15
15-20
Km
1.5 0 1 2 3 4 5 6 7
1:50,000

Fig. No 4.6

Table No. 4.7

Classes	Percentage	Frequency of Occurance	Percentage of Occurance
Ext. Low	0-5	6	22.22
Low	5-10	12	44.44
Medium	10-15	6	22.22
High	15-20	3	11.12

Danopur, villages and surrounding area lies with in this group. Phosphate content in soil in there area varies from 0-5.

LOW PHOSPHATE CONTENT AREA- This group is concentrated in 44.44% area of the total occurences of the region. The major parts of region particularly Goara taiyabpur, Panwara, Ibrahimpur, Malipur, Arka Fatehpur, Ghori Rampur, Beniram Katra, Makhaupur, Bhagwatpur, Ganja, and Jalalpur-Ghosi villages are within this group and soil phosphate in these areas varies from 5 to 10.

MEDIUM PHOSPHATE CONTENT AREA- This group is observed in 22.22 percent area of the total occurances of the region. In the villages of Rawatpur, Begampur, Bariawan, Basohar Khas, Lakshamanpur and Daryapur and surrounding areas have soils with phosphate content varying from 10 to 15.

HIGH PHOSPHATE CONTENT AREA- This group is observed in 11.11 percent of the total occurrence. Soils of Bakhshi

Mahada, Kasendha and Dania villages and there surrounding areas lie within this group. Soil phosphate in these areas varies from 15 to 20.

The distribution of phosphate in the soil shows that soil of the major parts of the region have very low phosphate in the surface layers. It has been observed that between pH 3.3 and 5.5, maximum of phosphate fixation takes place. But in the total part of the study area pH is above 7 which is not suitable for the fixation of phosphate.

In general, the soils of the region is low in phosphate which is probabley as a result of displacement. The comparatively heavy rainfall in the region has washed away the phosphates from the surface layers.

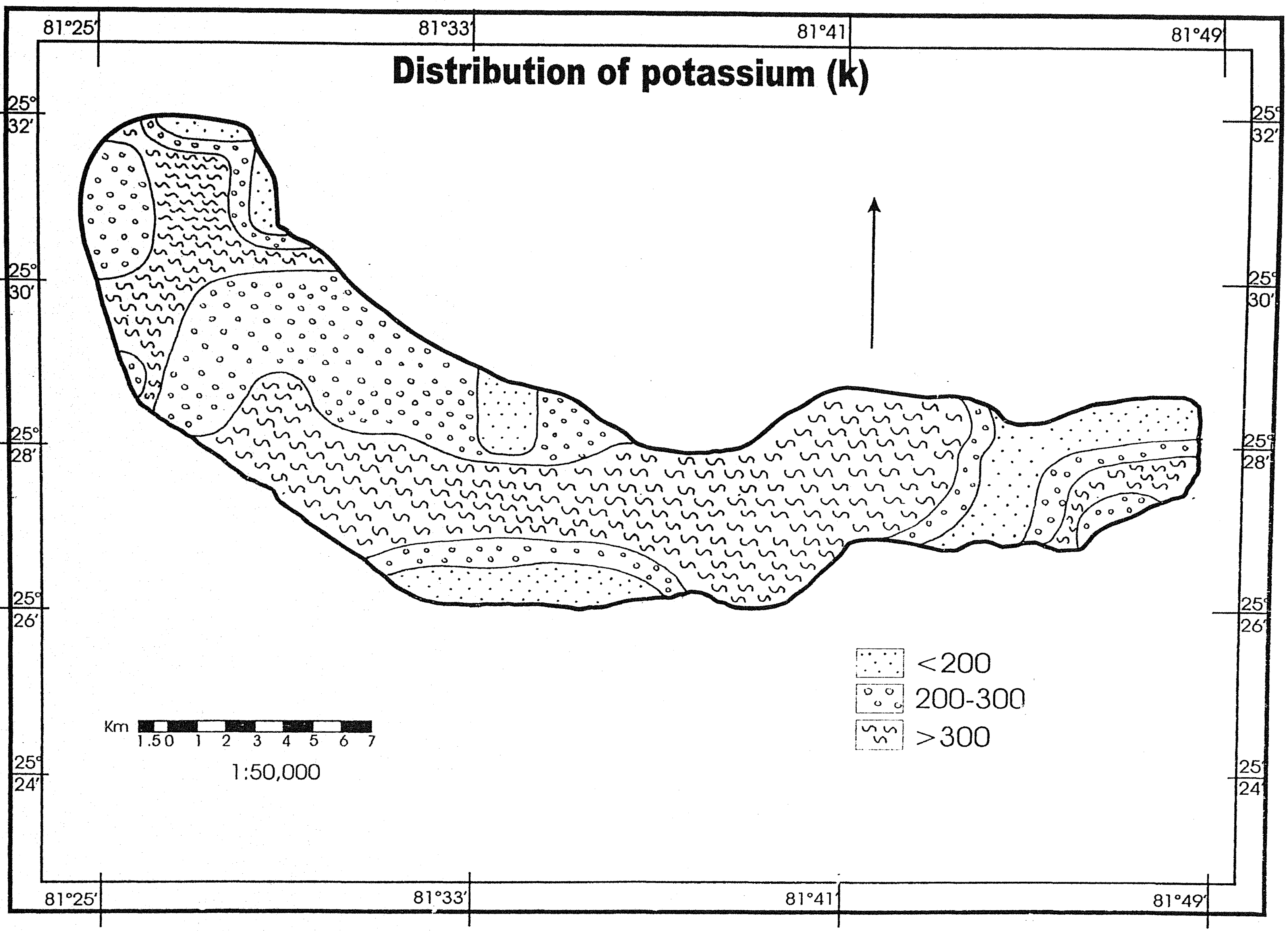
The fixation of phosphate in the soil depends laregely on the presence of micro organism and humus.

POTASH CONTENT OF THE SOIL- Wood ash has been applied for fulfilling the need of potassium in the soil for centuries. The name potash or potassium has been derived from the 'pot ashes' formerly, applied to the soil. Crops are mainly responsible for the heaviest removed of potassium, nitrozen and phosphorus from the soil. Potassium is necessary for the vital activity of the protoplasm in plant cells. It acts as a carrier of other substances. It helps in starch transformation and the translocation of sugar. The strangest notion about potassium is that the plant structure does not assimilate it. The plant takes up potassium in large amount but it all remains in the plant

sap. When the plant dies, rain leaches some of the potassium into the soil. On the other hand nitrogen and phosphorus, which are part of the plant structure, are not released until decay starts. Potassium activates crop resistence to certain diseases and encourages strong root system and thus helps to prevent undesirable lodging of plants and to neutralise the ill effects of excessive nitrogen. It acts as a delaying agent in the early maturity of plants and thereby resists undue ripening influence of phosphorus. Thus it imparts a balancing effect on both nitrogen and phospharus it should, however, be kept in mind that over abundance of this element or its shortage in the nutrient medium may retard the rate of photosynthesis. Growing plant tissues, buds, young leaves and live bark are rich in potash. Potash deficiency in the soil causes injury to the plants and short fall in yield of the crops. The leaves of the crops look dry and scorched at the edges and their surface becomes irregularly parched.

Any soil that has grown frequent crops of heavy feeding plants e.g. potatoes, sugar beets or tobacco should be checked for portassium deficieney. The chief potassium fertiliser is potassium chloride (muriate of potash). Potassium sulphate is also a potassic fertiliser. Time, manner and quantity of potassium application in a particular field and a particular crops depend on a number of factors.

THE DISTRIBUTION OF POTASH IN THE SOIL OF THE REGION- Distribution of potash content in the study area reveals that



Distribution of potassium (k)
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
<200
200-300
>300
Km
1.5 0 1 2 3 4 5 6 7
1:50,000

the percentage of organic matter is high. The amount of potash present in the soil ranges between 152 to 400 kg per hectare.(fig.no. 4.7) This amount is in the soil due to the social forestry. Low amount of potash in some patches to some extent is due to extensive use of land for agriculture. Potash deficiency is due to temperature and moisture condition. Such dificiency is commonly found in heavily lecached lateritic soils in the humid part. The area under study belongs to the tropical region.

According to the wide variation of the potassium content the soils of the study region have been classified into following three groups in the table no. 4.8

Table No. 4.8

Class	Kg/hect.	Frequency	C.F.	Percent of frequency
Low	152-200	5	5	18.53
Medium	200-300	9	14	33.33
High	300-400	13	27	48.14

(1) LOW POTASH CONTENT AREA- This group belongs to 18.5 percent area of the total occurances. Soil of eastern parts except south east of the region with a small patch in middle have low amount of potash.

(2) MEDIUM POTASH CONTENT AREA- This category exhibits 33.33% area of total occurances. Most of the soils of western part with extreme south east part of the region

and in the con necting areas, potash content varies between 200 to 300 kg/hect.

(3) HIGH POTASH CONTENT AREA- The high potash content area is concentrated in 48.14 percent of total occurances. The soils of middle part of region and connecting areas contain potash varying from 300-400 kg/Hect.

SOIL ACIDITY (PH) OR HYDROGEN - IONCONCENTRATION: pH is – log [H+], where [H+] means concentration of hydrogen ion. PH determines acidic or basic nature of the soil. Soil reaction is expressed in terms of pH value, that is the concentration of hydrogen ions (h+) in the solution. A soil is said to be acidic if the pH is less than 7 meaning thereby more H+ ion concentration, neutral if it is 7 and alkaline if the pH is above 7, which means that the H+ concentration is less. The direct effect of pH on plant growth is small, but indirectly it plays a vital role in agriculture by controlling the quantities of nutrient chemicals which are made available to the plant.

The soils of the region have shown pH value of more than 7 indicating that they are alkaline in their character (Table No. 4.9).The pH of the soil of the study region varies from 7.3 to 8.2. From table it is clear that the 3.7 percent of the soil samples are slightly alkaline, 74.08 percent are moderately alkaline and 22.22 percent are strongly

alkaline. According to the variation of pH value in the soil the region may be classified into following different groups.fig.no. 4.8.

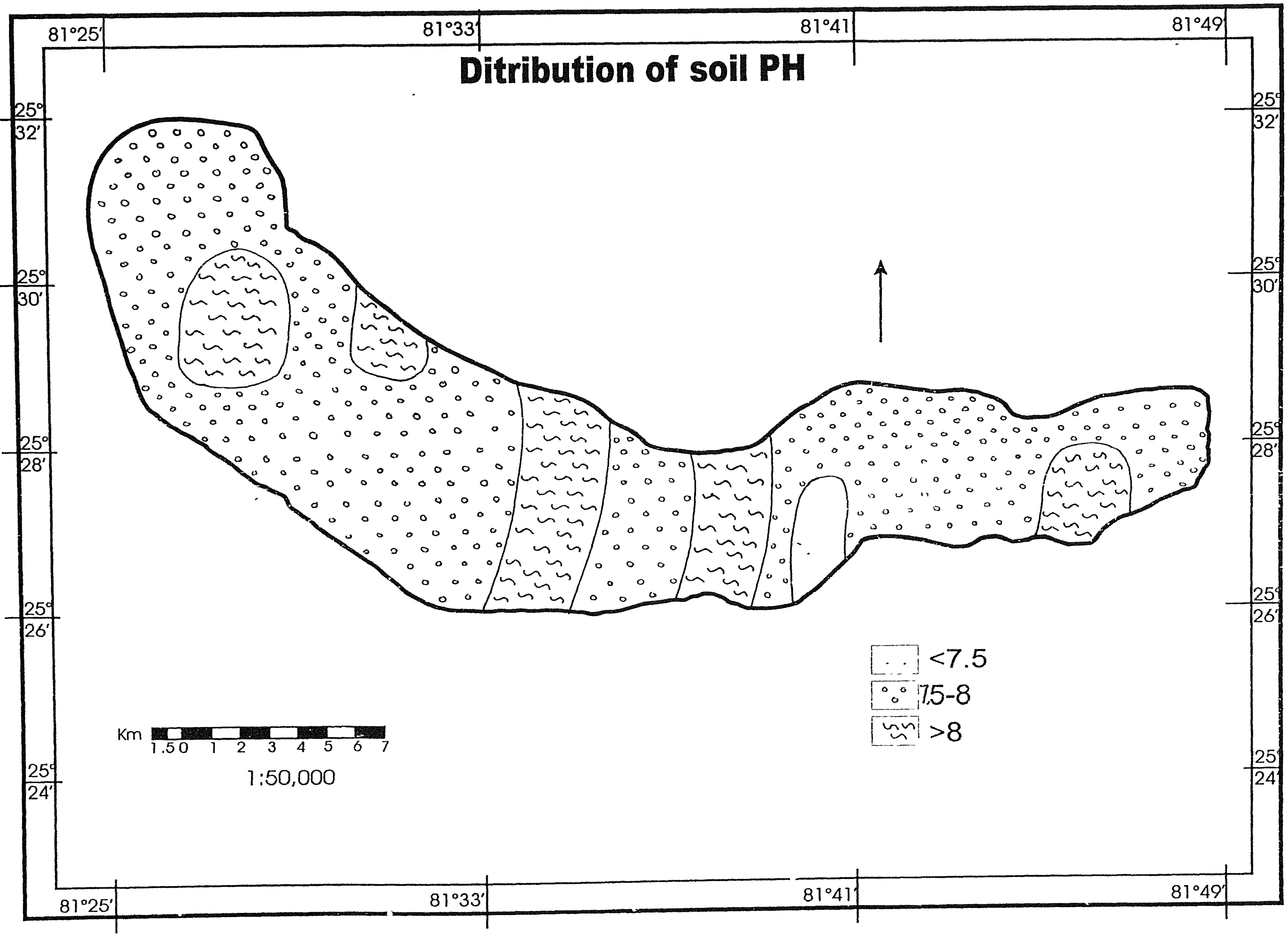
Table No. 4.9

Category	PH value	Frequency of Occurance	Percentage of Occurance
Slightly Alkaline	7.3-7.5	1	3.70
Mod. Alkaline	7.5-8.0	20	74.08%
Strongly Alkaline	8.0-8.2	6	22.22%

SLIGHTLY ALKALINE SOIL REGION- This group belongs to 3.7 percent area of the total occurances in the region. Only kadilpur village and their sourrounding areas have pH value within the range of 7.3 to 7.5

MODERATELY ALKALINE SOIL REGION- This group is concentrated in 74.08% area of total occurances. Soils of western, northern and eastern parts of the region except two small patches have pH value with the range of 7.5 to 8.0. These are located in Goara Tiayabpur, Mahend, Daryapur, Ibrahimpur, Laxhamanpur, Myoharkhas, Malipur, Ghori, Basohar Khas, Rampur, Beniram Katra, Makhaupur, Begampur, Bahagwatpur, Ganja, Kathaula Ghauspur, Jalalpur Ghosi, Pipalgaun, Damopur and Bakshimahada villages and their surrounding areas.

STRONGLY ALKALINE SOIL REGION- This group is found in 22.22 percent area of total occurrances. Soil of the middle part of



81°25'
81°33'
81°41'
81°49'
Ditribution of soil PH
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
<7.5
7.5-8
>8
Km
1.5 0 1 2 3 4 5 6 7
1:50,000

Fig. No 4.8

the area under study especially Bariawan, Dania, Kasendha and two other patches panwara and Rawatpur have pH value within the range of 8.0 to 8.2.

The distribution map shows that the entire region have alkaline soil. It is due to climatic influence of the region. High temperature and heavy rainfall and absence of thick forest except social forestery and that too in patches have given rise to alkaline soil. The depth of water table, temperature and moisture condition of the soil determine its acidity. Soil in region of low rainfall, high temperature and having very low water table have high pH value because of high soil water ratio.

SALINITY OF THE SOIL (E.C.)- Salinity of the soil is determined by electrical conductivity (E.C.). Salinity means the predominance of chlorides and sulphates of sodium and magnesium in the soils. The presense of salt in the soils affects the growth of various plants. Cultivation is not possible on saline soil unless they are flushed out with large quantities of irrigation water. From the figur 4.9 it is clear that the soils of the total region are non – saline (Salinity effects most negligible) and, hance, the general growth of the plants is not adversely affected.

The aforesaid shows the salinity of soil of different groups but there are other factors also which govern the amount of salinity in different regions.(fig. no. 4.9.)

Electric Conductivity (E.C.)

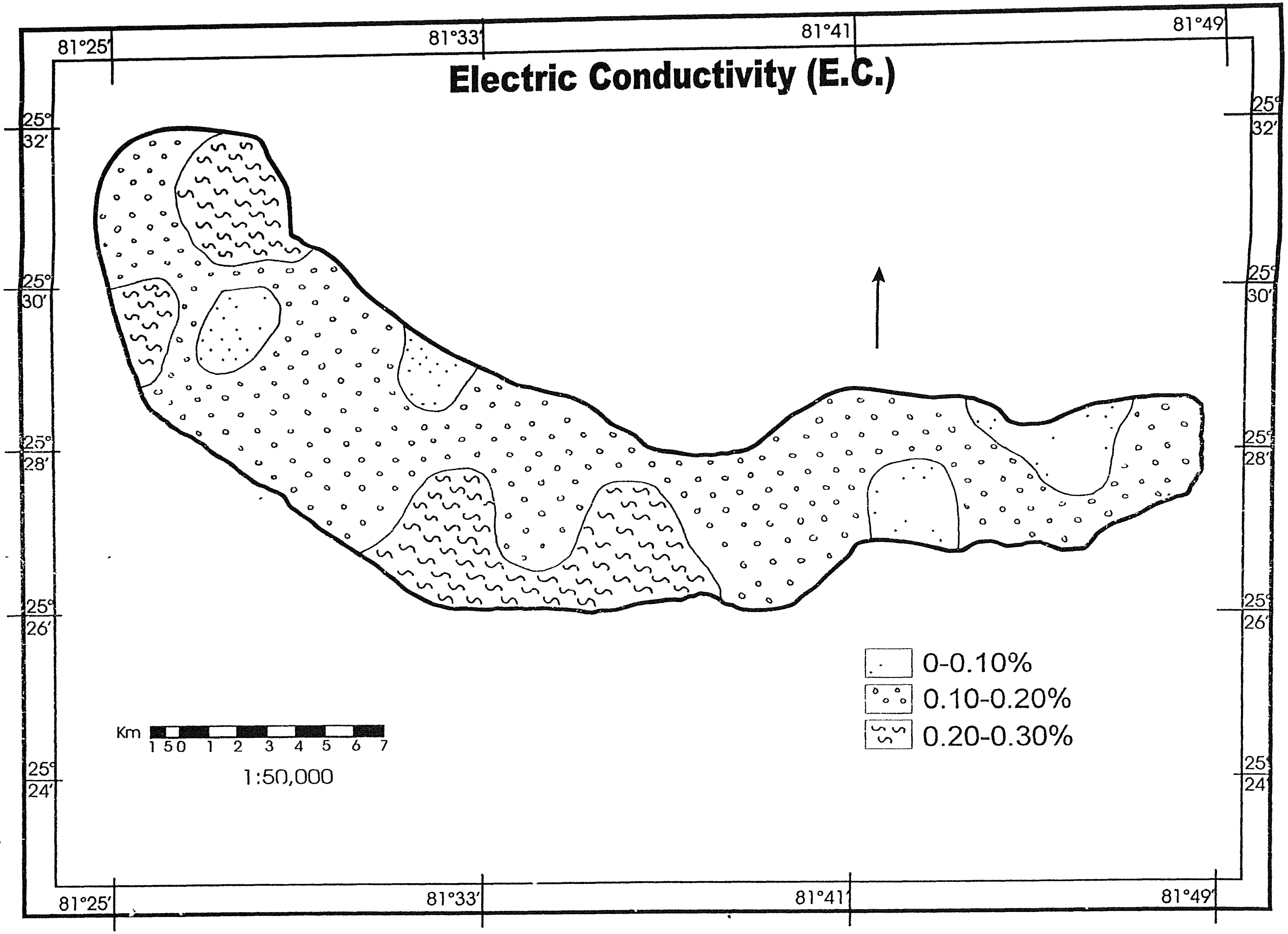


Fig. No. 4.9

Table No. 4.10

Classes	Frequency	Cumulative Frequency	Percent of Frequency
0.00-0.10%	6	6	22.22%
0.10-0.20%	17	23	62.96%
0.20-0.30%	4	27	14.81%

1. LOW SALINITY AREA (Soils having Low Salinity)- This group is found in 22.22 percent area of the total occurrences. Eastern part of the study region, particularly Ganja, Kathaula Ghauspur, Pipalgaun and Rawatpur villages and their surrounding areas and two other patches in panwara and Rampur villages and their surrounding areas have low amount of salinity. Soil salinity within these areas varies from 0 to 0.10 percent.

2. MEDIUM SALINITY AREA (Soils having medium salinity)- This category belongs to 62.96 percent of the total occurences. Soils of the western part of the region perticularly Goara Ibrahimpur, Malipur, Laxhamanpur, Myoharkhas, Arka Fatehpur, Ghori, Basoharkhas, bariawan, Dania villages and their surrounding eastern part of the region particularily Kasendha, Begampur, Kadilpur, Bhagawatpur Jalalpur Ghosi, Damopur and Bakshimahada village and their sorrounding areas have salinity within .10 to .20 percent.

SOIL FORMATION & FERTILITY

SOIL FORMATION

The factor that influences soil formation are: Parent material relief or topography, time, climate and biosphese. Large number of active micro-organisms in the soil increases its fertility. Improvement or deterioration of the beneficial organism depends on the living conditions and foodsupply given to these organism. This fact is of vital importance in the scientific manegement of soil.

Among the soil organism there are some that decompose organic matter, transform nitrogen, produce antibiotics, and others adversely affect plant welfare.

The parent material of these soils is primarily alluvium, deposited by river Ganga and Yamuna, transported from the central Himalayas which has sedimentary rocks e.g. shale schists, limestone, sand stone quartizites and phyllites etc. The alluvium is composed of in varying proportion of sand, silt and clay particles. These alluvial deposits belong primarily to pleistocene and secondarily to holocene period of the quartenary area. era

Composition of the sediments in the profile are sandy loam, loam sandy, clay loam/clay. Besides the presence of caleitic and ferromagnanitic nodules, coupled with ferromaganese mottles, also mark the differences.

Physiographically most of the study area lies on oldest flood plain of the river Ganga and Yamuna and alluvium is primarily homogenous hence have minor contribution on the genesis of these soils. The soils of the area are mostly immature and are under various stages of development.

The climate of the area is subtropical being uniform over the block area level. No climatic influences on soil formation may be expected. Nevertheless micro climatic effect particularly the soil moisture regime varies due to topography, viz, low land, mid land, and upland influence the geinesis of the soil. Various soils identified in the area have been differentiated according to their variability in pedogenic process as correlated with the variability in refief.

SOIL FERTILITY

Soil Fertility refers to the nutrient supplying properties of the soil. Like every living being plants need food, if they are to survive and grow. There is a good chance of rapid growth if they are well fed and tend to be strong and, therefore, accumulate power to resist the insects and diseases which are injurous for growth. The plants grow slowly and tend to be weak and produce insignificant yield if the soil is deficient in N.P.K. They may die before reaching maturity without setting seed if they are very poorly fed.

Out of 6 elements considerd essential for plant growth only 3 elements, viz., N.P.K. are rated as primary nutrients, as their

requirement is very high. The determination of their availability is termed as fertility status. Soil testing is approved on practical method of soil fertility evaluation. The soil reaction (pH) plays key role in nutrient availability in soil and as such it is an indis-pensable parameter in soil testing. Estimation of these parameters forms the basis for bringing out fertilizer recommendation for different crops under different set of conditions since it is not feasible to get the soil sample tested from each field during each crop season, a blanket recommendation for an area can be drawn out on the basis of nutrient indices. An attempt has been made in this direction by collecting soil samples and obtaining result of test carried in the laboratory of the department of agriculture, Pratapgarh. The nutrient indices worked out by the technique envolved by department of Agriculture U.P. Village wise nutrient indices are presented in fig. No. 4.10 (Fertility Status). Fertilizer recommendations for different crops are given in table no. 6.10.

Fertility map is prepared by ranking in ascending order the three main nutrients such as nitrogen, phosphate and potassium. Most part of the region have medium amount of fertility in the soil. Fig.No. 4.10 shows that soils of middle part of study region are richer in plant nutrients as compared to the soils of other parts of the region which have low fertility status (N.P.K.). Most of the area of the study region are forest free and have low amount of organic matter resulting in low supply of soil nutrients forest covered areas naturally involve high

N.P.K. By Ranking

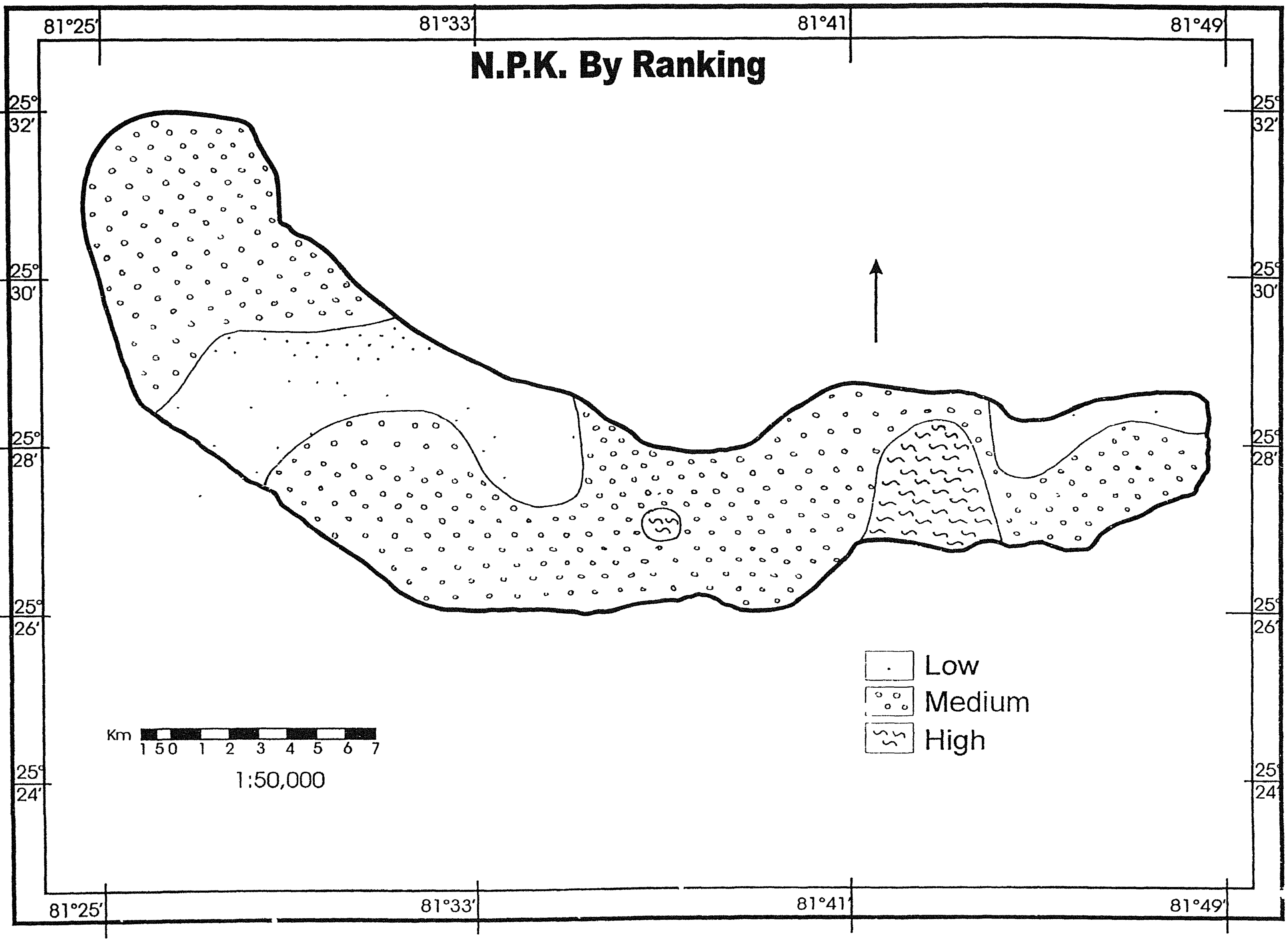


Fig No 4.10

amount of soil nutrients but soil erosion and leaching keep the surface soil low in nutriants. Only the favourable location with minimum erosion and leaching have high amount of soil nutrients.

SOIL CLASSIFICATION- The region under study does not show variety of soils but a wide range of variations in the physical, chemical and biological properties are well marked as already discussed. Soils brought down by rivers coverd the major parts of this region which are of two types

(1) Older alluviam called Bhangar

(2) New alluviam called khadar

Older alluvium (Bhangar) of more clayey composition is generally dark coloured and full of kankar. New alluviam khadar is generally light coloured and less kankary. The soils differ in consistency from drift sand loam and from fine silt to stiff clay. A few occasional pebble beds are also present. The formation of hard pans, at certain levels, in the soil profile through the binding of grain by infiltrating silica or calcareous matter, forming an impervious layer is often observed in these alluvial soil.

On the basis of properties of texture of the soil samples the soils of the study region can be classified into three broad categories as shown in fig no.4.11

Soil Map

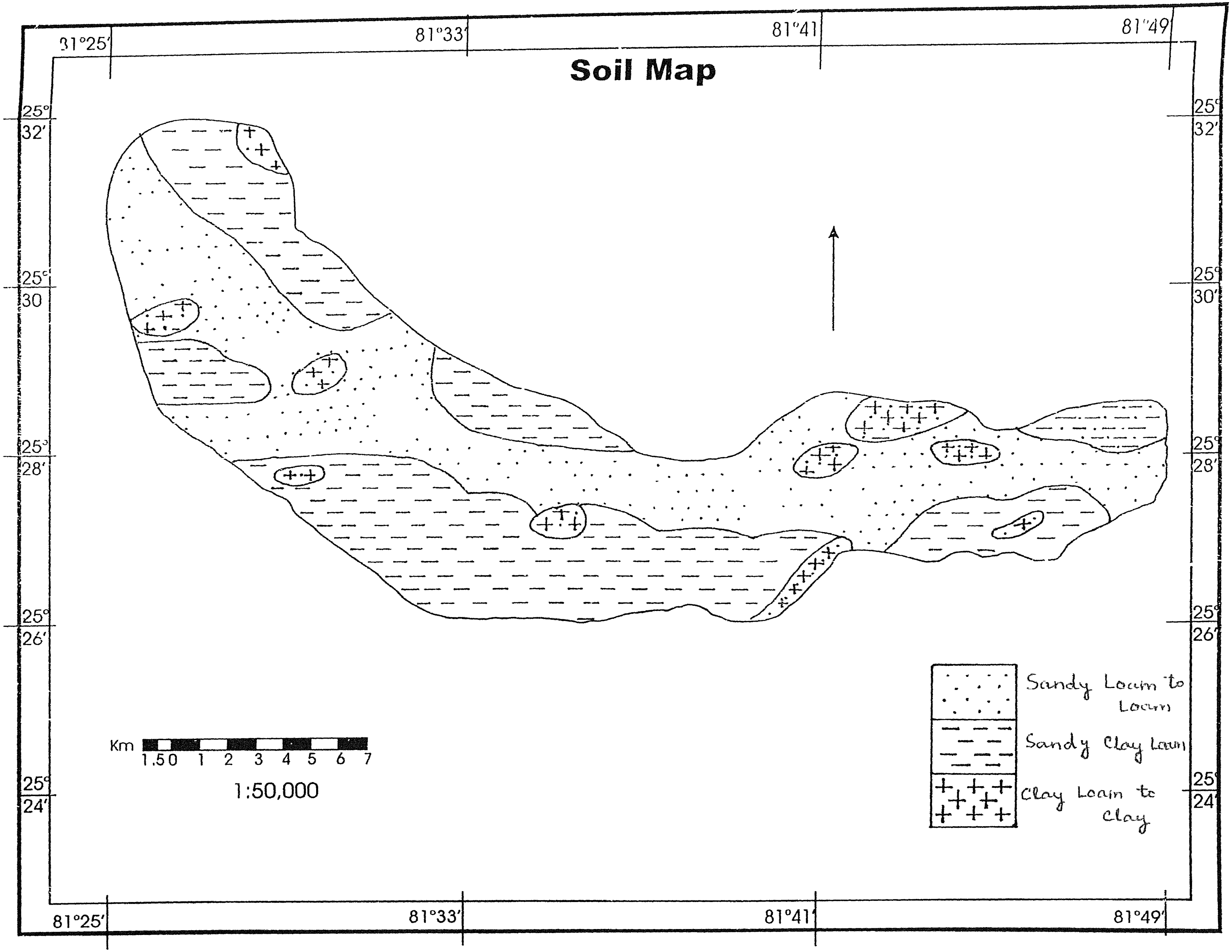


Fig. No. 4.11

TABLE NO.4.1
Result of Mechanical Analysis of Soil

Sl. No.	Villages	Sand%	Silt%	Clay%
1.	Goara Taiyabpur	49.0	16.0	35.0
2.	Mahend	51.0	25.0	240
3.	Daryapur	55.0	25.0	20.0
4.	Panwara	48.0	25.0	27.0
5.	Ibrahimpur	38.0	40.0	22.0
6.	Malipur	39.0	28.0	33.0
7.	Laxhmanpur	45.0	25.0	30.0
8.	Myohar Khas	35.0	45.0	20.0
9.	Arka Fatehpur	37.0	33.0	30.0
10.	Ghori	62	18	20.0
11.	Hashar Khas	40.0	30.0	30.0
12.	Rampur	48.0	22.0	30.0
13.	Beni Ram Kalra	28.0	40.	32.0
14.	Bariawan	45.	20.0	35.0
15.	Daria	50.0	22.0	28.0
16.	Makhanpur	48.0	30.0	22.0
17.	Kasendha	40.0	30.0	30.0
18.	Begampur	41.0	30.0	29.0
19.	Kadilpur	35.0	36.0	29.0
20.	Bhagwatpur	27.0	36.0	37.0
21.	Ganja	48.0	22.0	30.0
22.	Kathaula Gnauspur	55.0	24.0	21.0
23.	Jalalpur Ghosi	40.0	29.0	31.0
24.	Pipal Gaon	45.0	25.0	30.0
25.	Rawatpur	18.0	42.0	40.0
26.	Danopur	52.0	18.0	30.0
27.	Bakshi mahada	69.0	21.0	10.0

TABLE NO. 4.2
Result of Chemical Analysis of Soil

Sl. No.	Villages	Ec.	PH	A. V. N %	AV.P KG/Hect.	AVK KG/Hect.
1.	Goara Taiyabpur	.15	7.9	.063	9.0	272
2.	Mahend	.21	7.8	.061	4.5	400
3.	Daryapur	.27	7.9	.057	13.5	400
4.	Panwara	.09	8.1	.059	9.0	232
5.	Ibrahimpur	.14	7.8	.059	9.0	284
6	Malipur	.12	7.8	.035	9.0	200
7.	Laxhmanpur	.13	7.8	.057	13.5	400
8.	Myohar Khas	.19	7.8	.049	4.5	400
9.	Arka Fatehpur	.14	8.1	.030	9.0	280
10.	Ghori	.14	7.9	.042	9.0	266
11.	Hashar Khas	.16	7.7	.069	13.5	400
12.	Rampur	.07	7.9	.049	9.0	180
13.	Beni Ram Kalra	.28	7.5	.042	9.0	400
14.	Bariawan	.13	8.2	.042	13.5	212
15.	Daria	.18	8.0	.063	18.0	400
16.	Makhanpur	.28	7.7	.028	9.0	400
17.	Kasendha	.12	8.1	.040	18.0	400
18.	Begampur	.15	7.5	.045	13.5	400
19.	Kadilpur	.18	7.3	.071	4.5	400
20.	Bhagwatpur	.16	7.9	.063	9.0	400
21.	Ganja	.09	7.9	.075	9.0	356
22.	Kathaula Gnauspur	.07	7.8	.017	4.5	152
23.	Jalalpur Ghosi	.11	7.9	.049	9.0	164
24.	Pipal Gaon	.07	7.8	.018	4.5	156
25.	Rawatpur	.09	8.0	.066	13.5	236
26.	Danopur	.10	7.7	.057	4.5	152
27.	Bakshi mahada	.12	7.8	.057	18.0	250

Distributions of the principal soil types are: (1) Sandy Loam to Loam (2) Sandy Clay Loam (3) Clay Loam to Clay

(1) SANDY LOAM TO LOAM: This type of soil is found in a long uneven strip from east to extreme west. About

70 percent of the total area under study is covered by this category.

(2) SANDY CLAY LOAM: Sandy Clay Loam are found in patches covering about 25 percent of the total area lying in North West, Middle West, North East , South East and extreme East of the study region.

(3) CLAY LOAM TO CLAY: This category of soil is found in some scattered small patches covering a few part of the area under study.

INCIDENTS OF GULLY & SOIL EROSION

There is continuous process of movement of soil from one place to another due to natural forces. Rain and winds are the main agents causing soil movement, formation of streams, rivulets and river deltas loading to the gradual transformation of landscapes. The rate of soil removal are exceedingly slow under a cover of thick growing vegetation of grass and trees. The favourable natural soil balance is, however, seriously disturbed by human action to till the earth for food. Burning, cutting and destruction of the wild growth of vegetation and breaking the surface soil with crude implements by the primitive cultivations in the initial stages of the civilization accelerated displacement of soil. With the gradual development of civilization and incidently at the advanced stage when population pressure forced cultivation of steep slopes, the soil erosion was

recognised to be a serious human problem. The vastly accelerated process of soil removal brought about by human interference with the normal equilibrium between soil building and soil removal is designated soil erosion. This frequently called accelerated erosion and sometimes abnormal erosion (Bennett). It is the naked areas of earth surface which are prone to erosion. Nakedness may be caused by are, plough, grazing fire invasion of rodents or any other factor. Nakedness accelerates the rate of erosion because the upper, more absorptive layers of soil are successively removed. The humus charged granular topsoil is generally more resistent to erosion than the comparatively less absorptive, less stable layer beneath. Heavy rains tend to seal the pores of the naked fields, the larger openings in the body of the soil are chocked with muddy entries. The result is that underlying layers deficient in organic matter are exposed material, whether of clay or of coarser grain is more susceptible to erosion.

Water and wind are the active agents of soil erosion. The former agency differs from the latter in nature its action and outward manifestation but is similar in the sense that both remove and transport surface soil. The capacity of transportation of both the agencies increases with the increase in velocity. Both are responsible for obstructing the measures of defence and preservation of soil. General category of water erosion may conveniently be classified into

(1) Sheet erosion

(2) Rill erosion

(3) Gully erosion

<u>Sheet erosion</u>

Uniform removal of soil in then layers over an entire segment of slopy land is called sheet erosion. This process of erosion in the least visible and deceptive one. Frequently it causes the colour of the land to change by and by from dark to light because the removal of dark hued, humus charged topsoil exposes relatively light coloured, humu-s deficient subsoil. The removal of the top soil causing change in colour is also accompanied by a progressive decrease in yield.

The suseptibility of maked land to sheeterosion differs from place to place. The reasons of such variation are variations in top ographic features, climatic environment and the character of the soil. Slopy and slopier lands and those subjected to heavy or intense rain fall are most likely to be problem areas. Sheet washing of any field or pasture depends on the erodibility of the soil itself.

In the area under study places where a loose, sallow layer of surface soil overlies a dense subsoil of low permeability are specifically prone to thin form of erosion. Such places lie at some distance from the banks of the river. Places having soil of high silt content, fragile sandy soil, stiff clay and deficiency in organic matter are more susceptible to sheet washing. The soils deficient in organic matter in the river basin under study are located around the villages

Kathaula Ghauspur, Pipalgaon, Mahipur, Arka Fatehpur, and Makhanpur and related areas. In these areas organic matter content varies from 0 to 0.40 percent.

Sheet erosion occurs wherever water flows over naked or unprotected slopy land. Almost entire area under study except a few patches in sirathu Manjhanpur and Kaushambi blocks is devoid of natural forest. The result is that water run off from unprotected areas is always muddied in comparision to the run off from wooded and grass covered areas.

Sheet washing takes place very slowly. The farmers often fail to take notice of its effects or even to understand the cause of the colour change in the sloping fields or the appearance and widening of spots of relatively unproductive subsoil or bed rock exposed by erosion (the change in colour due to sheet washing is visible in photographs to 7 and 8) some of the owners of the fields see and realise the changes caused by the erosion but many of them do not understand the cause and are inlived to look upon such change in the soil due to some undefinable natural cause.

Photographs no. 7 and 8 illustrate how sheet washing displaces soils from unprotected areas. Here the protection afforded by a single gravel or fragment of sandstone allowed columns of soil several iniches high to be formed through the simple process of cutting away the surrounding uncovered, unprotected soil by running water.

Sheet erosion grades so undiscernably into rill erosion that both cannot every where be sharply differentiated.

Rill Erosion

Instead of flowing uniformly over sloping field water run off generally tends to concentrate in streamlets of sufficient volume and velocity which accelerate cutting power. The result of th_in form of run off is rill erosion which in contrast to sheet washing is characterised by small but well defined cuts ingrawed in the land surface by the incisive action of the water run off. Rill erosion is mostly common in regions of intense precipitation and lands of absorptive capacity. The photograph no. 12 exhibits the rill erosion the area under study.

Gully Erosion

Gullies are created by concentrated and forceful run off from a slope. The increase in volume and velocity of water run off causes deep incisive cuts in the land surface. The continuous concentrated, flow of water keeps on widening the incision. Usually gullies follen sheet erosion or they result from the neglect of rills. But frequently they start from the slight depression of the land surface where water run off normally concentrates. Often they develop in natural field depression or in cuts caused and left by the wheels of farm machinery driven up and down over soft ground. They are frequently formed also

in the trails of livestock and along furrows running up and down the slope.

Channels created by erosion carry water only during or immediately after rains. Gullies once formed can more easily be got rid of by normal tillage. Most of them having sufficient depth and width can not be crossed over by the farm machinery. Once the process of gully formation is started the shape of the incision is generally influenced by the relative stiffness or resistance of the soil strata and underlying rock material. Surface and subsurface of the alluvial soil are friable and easily cut by running water. Thus lands formed by alluvial soil are susceptible to gully formation and in such condition gullies tend to develop vertical walls which result from undermining and collapse of banks. The photographs no. 3, 5, 6, 7, 8, 9 and 10 bave been taken as samples of gullies from different areas under study. A persual of these photographes particularly photographs no. 5 and 8 indicates the branching of gullies. Gullies extend at the heads and along the sides due to water flow over the banks and they branch readily. Many of the branches and washes that have deep cuts in the landscape of varius parts of east and south east regions of the area under study are examples of "u" shaped type of gully.

The under cutting or "u" shaped gully is one of the most destructive types of erosion and is most difficult to control. Special methods are required to control the growth of gullies which have

developed to considerable size. The gullied areas can be reclaimed for agricultural use. This can be done by establising vagetation which is most economical and satisfactory, although in some cases, particularly in large gullics, the hue of close growing plants may be required to be supplemented with mechanical measures. Soddy daus brush, straw, log or loose rocks may be helpful to check run off and collect silt favorable to plant growth during the gestation of the protective vegetation.

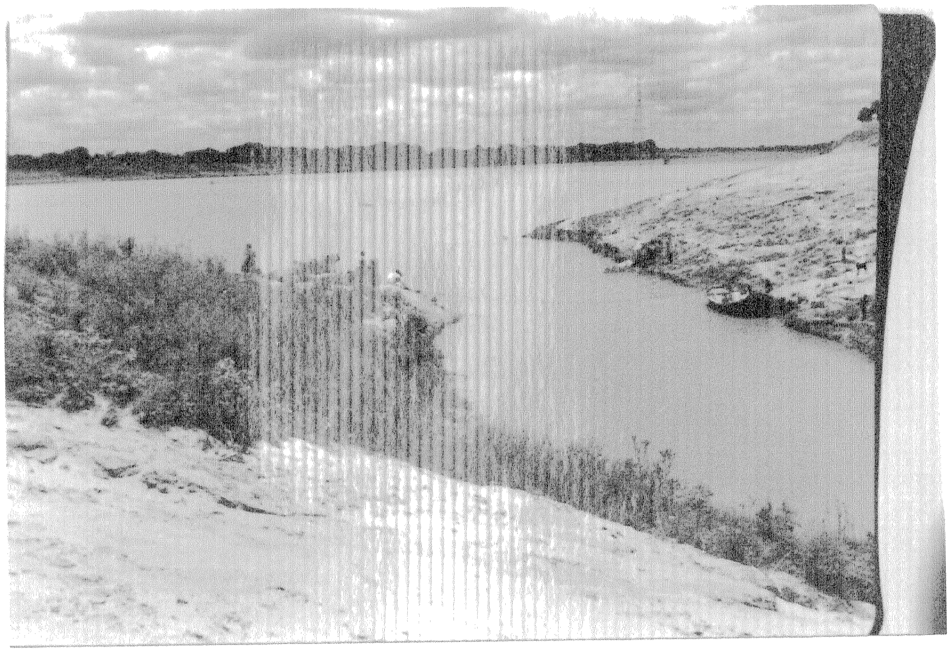
CHAPTER-V

FLUVIAL PROCESSES, RIVERINE ENVIRONMENT AND MANAGEMENT OF GEOMORPHIC ENVIRONMENT

GEOMORPHIC PROCESSES

All those physical and chemical changes which affects the form of the earth's surface are described as geomorphic processes. The natural medium which secures and transports earth material is called geomorphic agent, for example running water, ground water, glaciers wind and movements of standing waters including waves, currents, tides are the effective geomorphic agents. These agents operate to remove, transport and deposit materials from one place to another. Most of the geomorphic agencies have their origin within the atmosphere of the earth and start functioning under the direction of the gravitational force, Earth's gravity has no role in transportation of material and that is why it is considered to be a directional force. In addition to these agents man and other organism also play their role as geomorphic agency. The aforesaid agencies are exogenous. Other geomorphic processes originate within the earth's crust and they are classed as endogenus e.g. diastrophism and volcanism.

The study of the form of the earth is meaningful only when attention is paid to gather information about the development of land form. Such information can be obtained from the following sources:



PHOTOGRAPH NO. 1 : MOUTH OF THE RIVER

PHOTOGRAPH NO. 2 : SOCIAL FORESTRY

(i) Information can be obtained by mapping and measurement about the form of the land and by spatial distribution of land forms

(ii) Information can be collected on the processes which shape the surface of the earth at the present time because these processes are responsible for the outcome of particular types of land forms

(iii) The analysis of deposits can make available sufficient information about the processes and chronology of events, which took place in the past.

The above sources though very important for a geomorphological study but information from these sources is not always easily related. It is not practicable to associate a particular process with a particular morphological feature. The reason is that the mechanisms of the processes are complex as more than one processes are involved in the evolution of a particular form. In many areas the processes operating at present are not the same, which were responsible for shaping the land forms of that area. Even the present rate of operation of geomorphological processes also differs from the rates operating in the past. It is also important to mention that lack of requisite data and inconsistency of available data makes it obligatory to compute the relevant and required geomorphological data on the basis of a few formulas.

The geographical study of a river is required inter alia for the following three main reasons:

(i) A river flows and exists in the physical landscape and plays a vital role in fashioning a fluvial land form

(ii)The river occupies importance in - directly in relation to many other geomorphological processes in fluvially dominated land scapes

(iii) The river is very important for human use. It is no wonder that human settlements in the initial stages of civilisation started around the riverbanks.

River and streams cause erosion and in their run off transport a load of sediment and deposit it at different places. Thus fluvial erosion and resultant deposition produce distinctive features such as under cut river cliffs, potholes and alluvial plains. A variety of landform come into existence by the direct action of the river. However the river also plays its role in joining the landscape forming processes during the landscape evolution.

The lower basin of sasurkhaderi river is a part of the famous Ganga Yamuna Doab in the Kaushambi district. It has undergone different stages of its development. It has almost plain surface except the erosional topography particularly at the end where this river meets and loses its identity in the river Yamuna. In the succeeding Para graphs of the present chapter attempt has been

Surveyed Area Of The Study Region

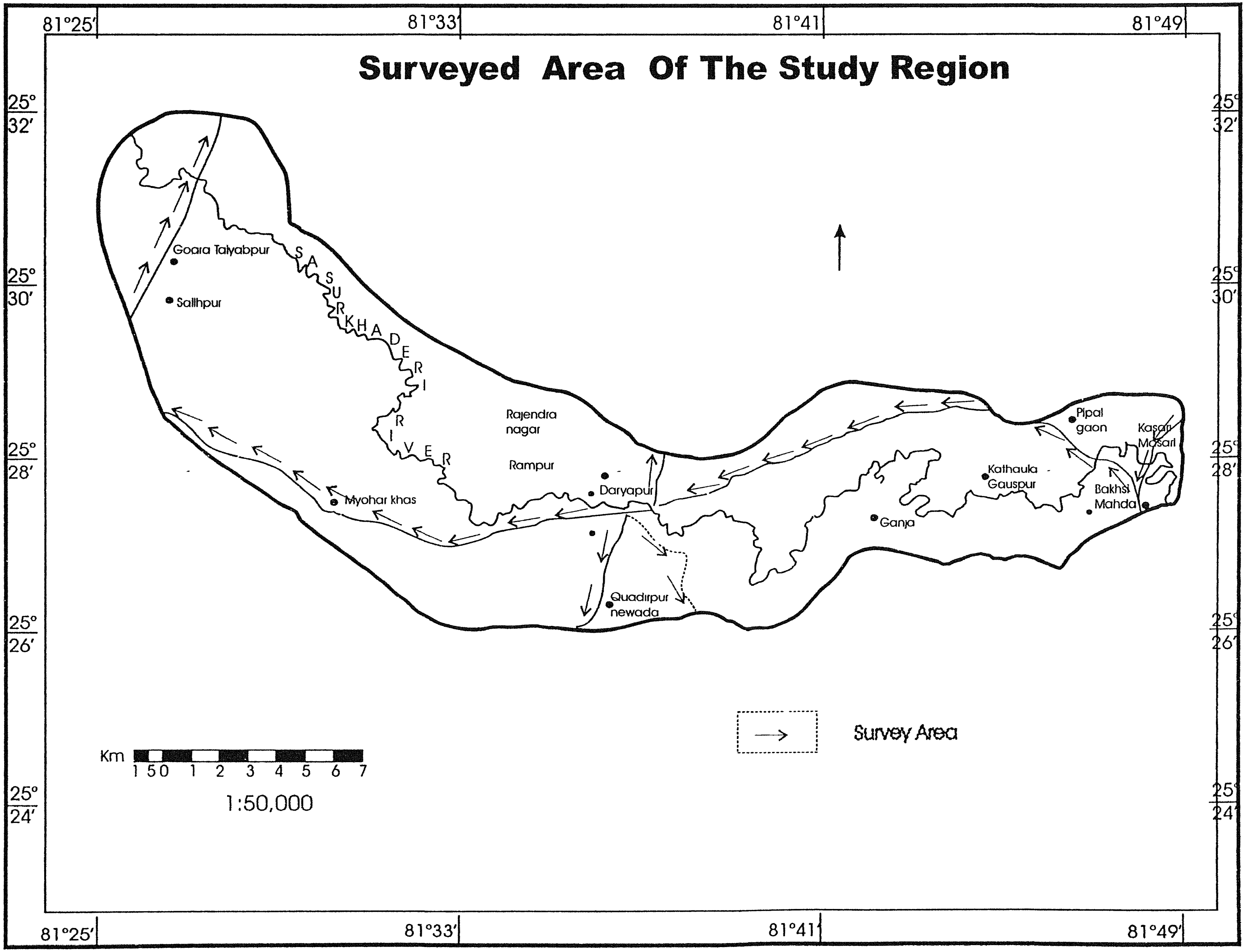


Fig. No. 5.1

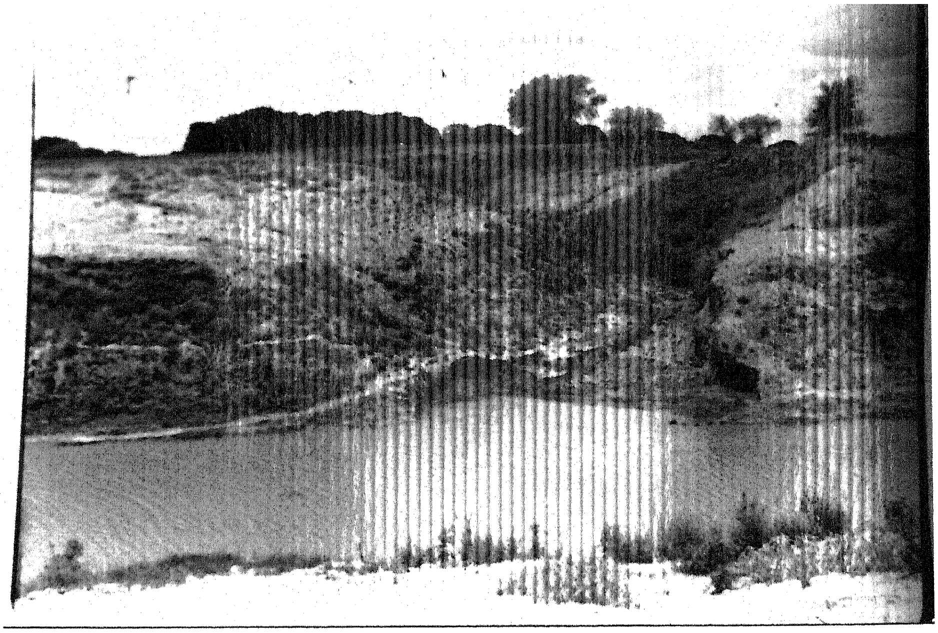


PHOTO NO. 3 : GULLY FORMATION where?

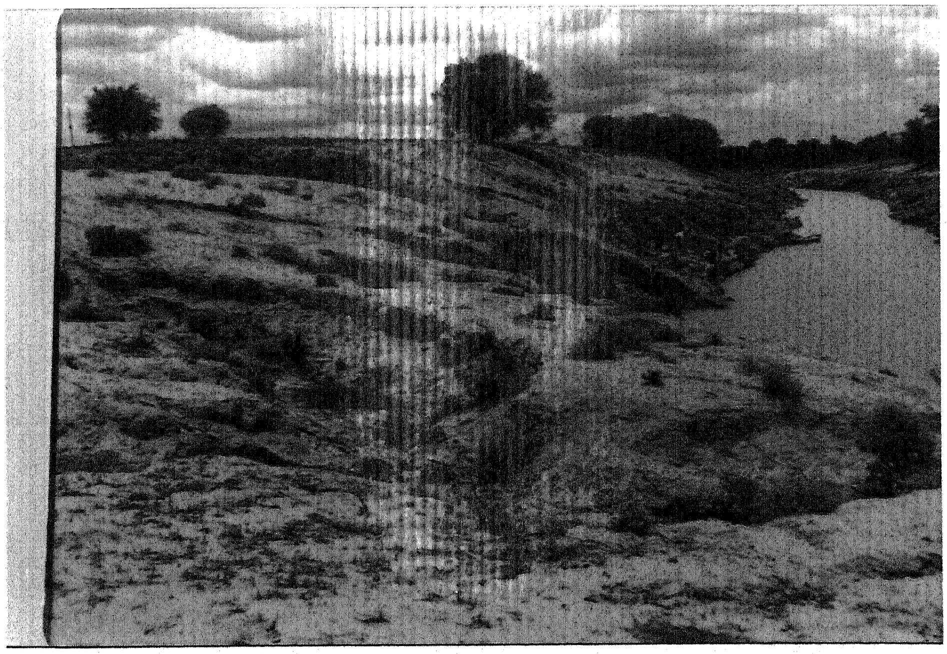
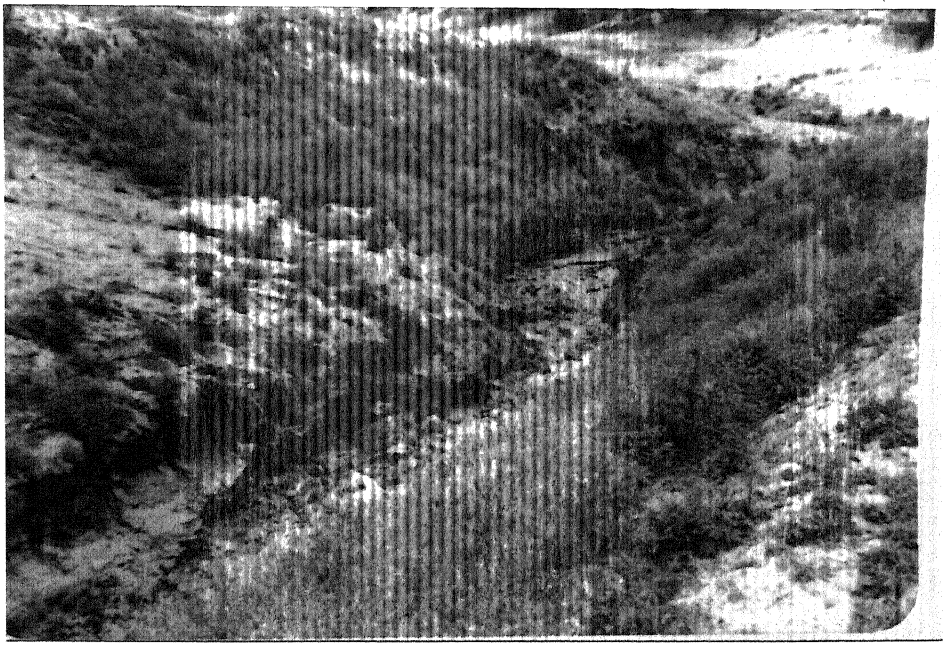


PHOTO NO 4: SOIL EROSION

made to present the study and interpretation of fluvial processes, mechanism of silt transportation, er~~or~~osion and deposition; geometric properties and profile analysis of the river channel; riverine environment and associated morphological features; weathering processes; and ravination and associated processes. Fig.No. 5.1 shows the surveyed area of the study region (Root Map).

FLUVIAL PROCESSES: The river or drainage basin in the entire area is also called catchment~~s~~ area, which provides run off to the main stream and its tributaries. The volume of water yield from the catchment~~s~~ area depends on the size of the drainage basin. The length, width, shape and relief decide the rate of flow and sediment yield. Topographic features need to be considered in the context of the ways in which they impart influence on the drainage basin process but it is also important to keep in view the multiform relations which exists between the different features; for example between the shape of the catchments area and the nature of drainage pattern. The measurement of different aspects of river and the drainage basin i.e., the length of the rivers and their branches and their relation between them are the most important factors which provide~~s~~ an elaborate and rather some what precise knowledge of the land forms of particular place of a region.



PHOTOGRAPH NO. 5 : GULLY FORMATION

PHOTOGRAPH NO. 6: GULLY FORMATION

The absolute relief of the study region has been classified into two broad categories and has been shown in the Table No. 2.1. The variation in the elevation of the earth's surface at any point is called relative relief. The topographical sheets of the study area as demonstrated in survey of India map has been divided into 301 grids and five categories of relative relief have been identified and has been shown in the Table No 2.2 The gradient of the basin has been grouped in 6 categories and has been shown in table no 2.3. The study region is depositional plain in origin and is almost a level plain sloping gently toward south east of the region. The total catchment area of the river basin under study is 30100 hectares. The discharge of the river has been calculated on the basis of empirical formula:

$$Q = C M^{3/4}$$

Where Q is equal to discharge in cusec., C is a constant varies from zone to zone with in 15-35 and M is equal to catchment area in square miles.

The discharge has been calculated on the above formula after taking C equal to 25 i.e. average of (15+35) and the discharge of catchments area under stud-y during rains calculates to 903.5 cusecs.

The breaking of soil and its displacement is called soil erosion. The main natural agencies, which cause erosion are wind

and water. It is their velocity, which provide energy for soil erosion. The favorable natural soil balance was however, disturbed from the time man started to till the earth for obtaining food. Burning of the wild growth of vegetation and breaking the surface soil with crude implements by the primitive cultivators in early days speeded up the soil removal. It is pertinent to mention that when the population pressure forced cultivation of steep slopes the soil erosion was recognized to be a serious human problem. Thus natural and unnatural forces are at work and share the responsibility of erosion but we are here concerned only with the natural forces particularly the fluvial processes which are responsible for erosion, carriage and deposition of soil. It is the gradient or slope of earth's surface, which provide energy to water run off to cause erosion, transportation and deposition of soil. The interaction of the fluvial flow with the erodible materials in the catchments area of the river basin determines the morphology of the river channels. The main underlying problem is to comprehend the interaction involving the distinct processes of removal, carriage and deposition of sediment. The basic mechanical principles are well known but an analytical solution still to be found out. The reason is that natural streams represent the movement of mixture of both fluid and solid in areas, which are themselves subject to deformity. Even the motion of a single particle can not be

explained precisely and when the moving material is cohesive the problem becomes more complex and acute. Since a larger flow involves velocity, a discussion of stream flow fluctuation provides a basis for the under standing of the mechanical work performed by streams.

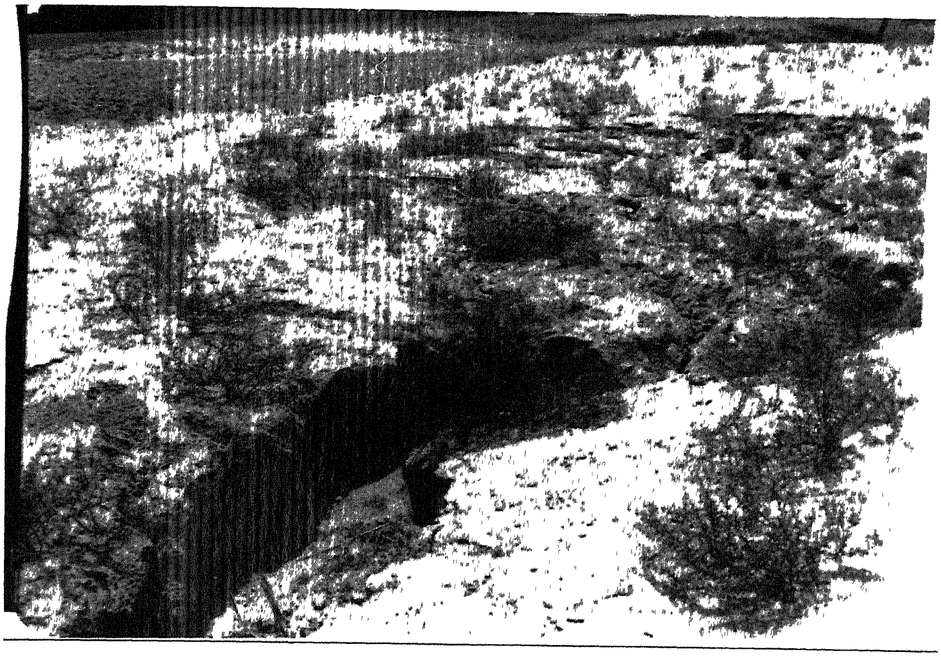
Water flowing in an open channel has to encounter two main forces; firstly gravitational force which compels water to move in the down slope direction, and secondly friction which opposes down slope motion. The relationship between these two forces finally determines the ability to erode and transport eroded material. The entrained load of eroded material carried by natural streams can be separated into three components

(i) The dissolved load consisting of material transported in solution

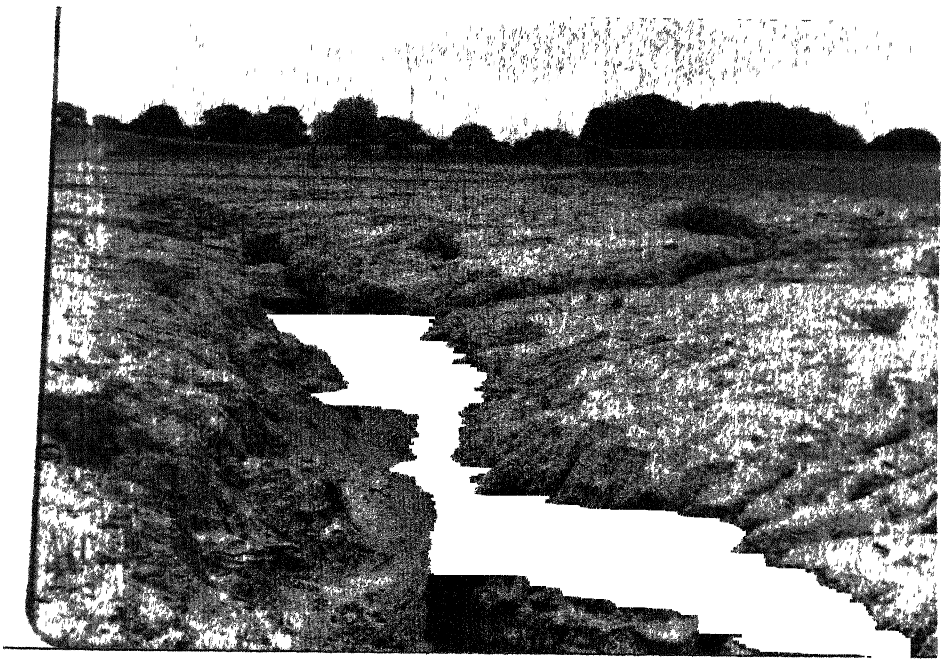
(ii)The wash load, comprising particles finer than those usually found in the bed and moving readily in suspension.

(iii) The bed material load including all sizes of material found in large quantity in the bed.

The region under study forms part of vast expanse of Doab created by the fluvial deposition of the river Ganga and Yamuna the two of the biggest rivers in northern India, which have under gone through the processes described in detail



PHOTOGRAPH NO. 7 : EROSION OF SOIL



PHOTOGRAPH NO. 8 : EROSION OF SOIL

in the preceding paragraphs.

GEOMETRIC PROPERTIES AND PROFILE ANALYSIS OF THE RIVER CHANNELS

The study of geometric properties and profile analysis of the rivers of the Ganga Yamuna Doab region of Kaushambi district is concerned with the assessment and critical analysis of the channel morphology which is responsible for shaping the environment and sculpturing and chiseling the morphological features of varying genetic features. It is pertinent to mention that the Ganga Yamuna Doab of which the study region forms a part, presents a geomorphic landscape of highly developed, mature and aged river basins. The geomentric properties of the drainage requires the study of shape of the river under study from source to month in whichit is observed that how far the main drainage live deviates from its normal direction and alignment. The cross sectional form of river is characteristi - cally irreguiar out line and locally variable. Width and mean depth give the gross dimensions of the channel but do not uniquely define cross sectional shape (Hey, 1978). Never the less, width – depth ratio remains the most commonly used index of channel shape even though it is not always the most appropriate (Pick up 1976)

LONGITUDINAL PROFILE

The longitudinal profile of the river under study has been shown below:-

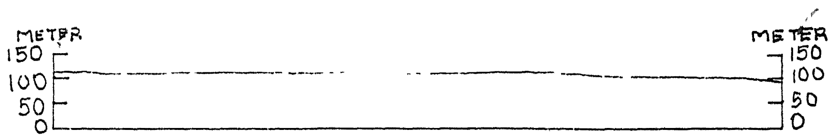


Fig. Longitudinal profile

The progress of sinousity of the river is influenced by structure, climate, vegetation and time. The sinuosity indices helps in the study of geomorphic features of the drainage basin. The study of sinuosity of a river requires various qualitative and quantitative techniques. This procedure involves the derivation of the departure of the observed path adopted by a particular river from the expected path of the river which is a theoretical path and is more or less straight line course between the source and mouth of the river. It is important to mention that "practically the straight line path of the river is never possible because it is affected by a number of causative faction, viz., geological and hydrological control, dep angles slopes absolute reliefs, relative relief~~ts~~ and stage of valley development etc. Which force the drainage line to deviate from its straight line expected path "(Singh and Upadhyaya 1982). Sinuosity, defined by David Knighton

$$S = \frac{\text{channel length}}{\text{Straight line valley length}}$$

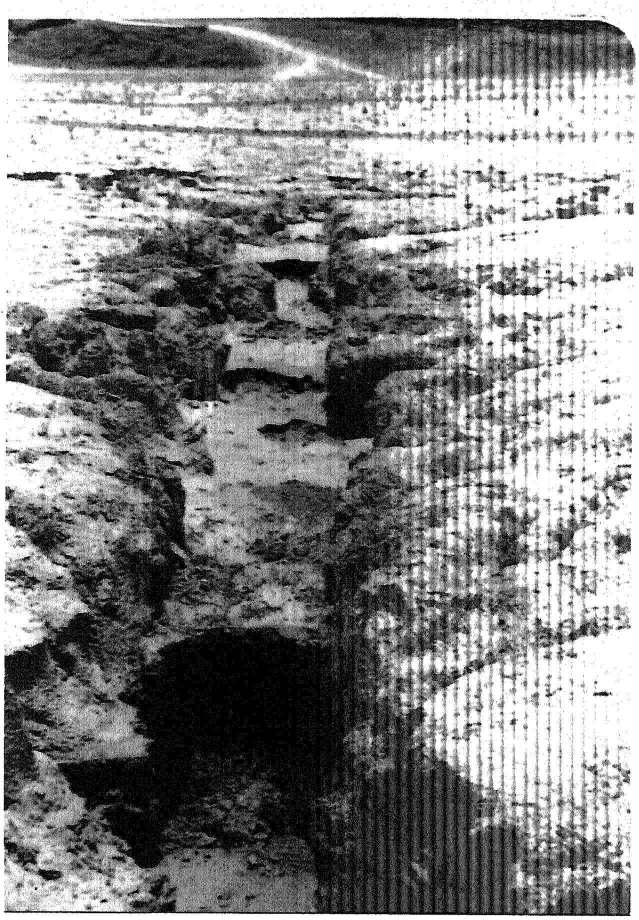
The sinousity of the river as per above formula calculates to 1·74

RIVERINE ENVIRONMENT AND ASSOCIATED MORPHOLOGICAL FEATURES

Running water is one of the most potent factors in cutting, chiseling and sculpturing and remodelling the landscape. Rivers not only cause erosion but also perform the function of transportation of eroded debris. Thus they provide a system of drainage which is slowly and gently balanced with rocks, climate topography and soils. The material transported by the rivers is from time to time started by deposition in the channel and the adjoining flood plains. These areas taken together on the whole form the ravine environment and are the natural domain of the river.

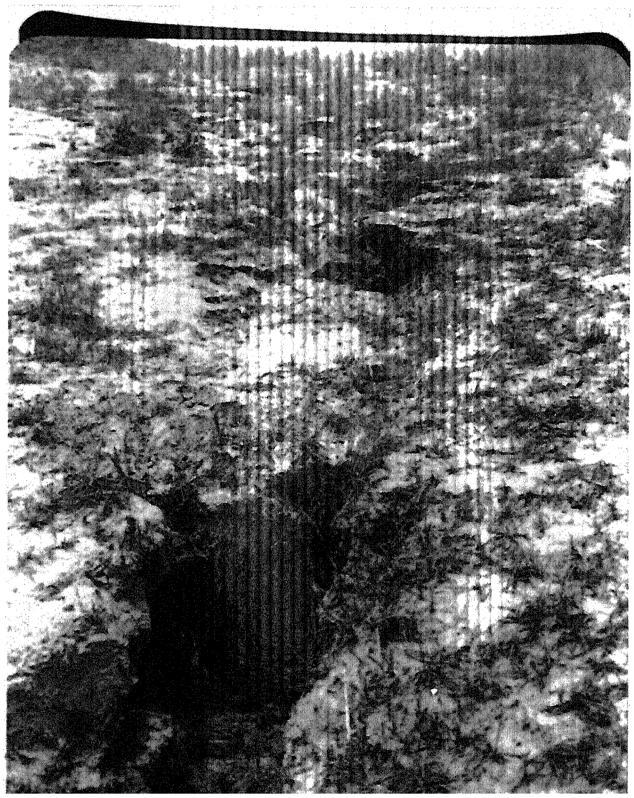
There are many morphological features in the study region such as ravination along the river bank shown in photograph no 3,8 and 13; extensive flood plain shown in photograph no 9; slumping of river banks shown in photographs no 3 and 4; one of the most important morphological features is flood plain.

The flood plain is essential product of river deposition. The formation of alluvium and structure of flood plain is a very complex phenomenon. The formation of alluvium begins with the development of stream (inshore) shoal resulting from traverse-circulating movements. These deposits laid down by the stream water are called fluvial or river alluvium. In the doab area of rivers Ganga and Yamuna surface is made up of well washed sands of



PHOTOGRAPH NO. 9:

GULLY FORMATION



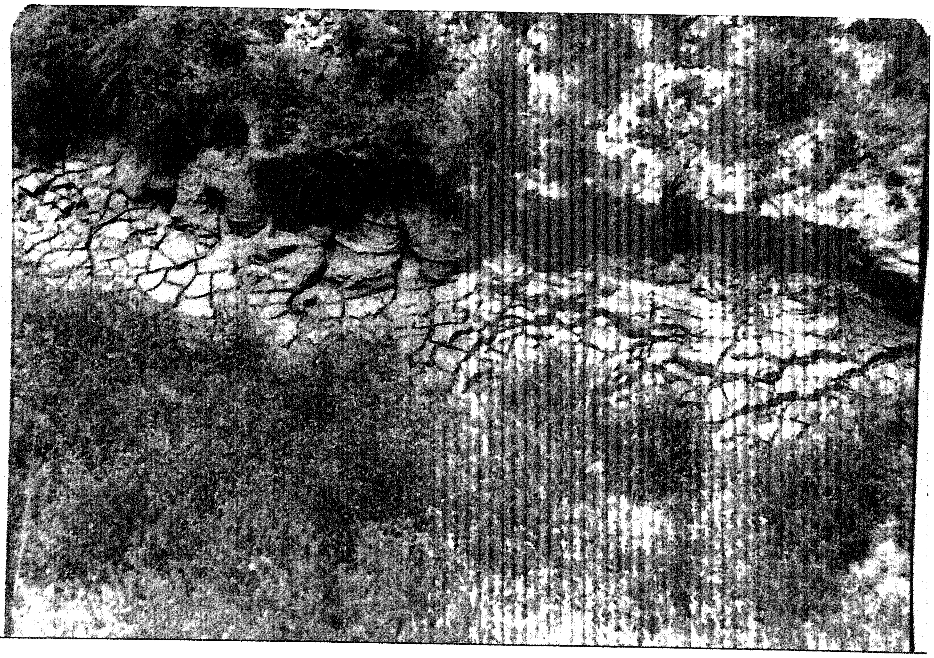
PHOTOGRAPH NO 10

varying grain sizes as the undermined concave bank recedes being succeeded by migration of the river channel, like channel shifting in Sasurkhaderi river. A gradual accretion of the fluvial alluvium takes place through an ever increasing number of layers, leaning against the inclined surfaces of the growing shoal. (Dube A.). The study region along both sides of the lower part of the river Sasurkhaderi contains streams and rills formed in the rainy season, which are also responsible for the formation of various features.

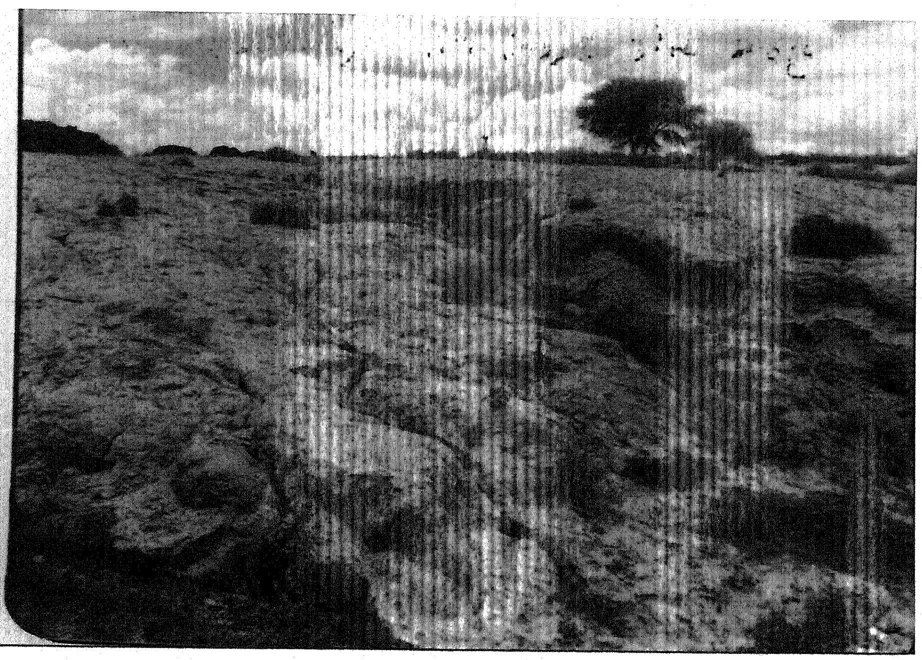
Formation of gullies due to headword erosion and fluvial action is also responsible for destroying the fertile cultivable area under study in the Kaushambi districrt.

WEATHERING PROCESSES: Weathering connotes processes causing decomposition or breaking up of rocks because of exposure at or near the earth's surface. Weathering does not include transportation or movement of disintegrated parts. The removal or transportation of decomposed or disintegrated rock debris is called erosion. Thus weathering is a static process where as erosion is a dynamic one. The combined processes of weathering and erosion give rise to denudation.

"Weathering is the work of wind, temperature water and organism that tend to break down the rocks by mechanical or physical and chemical change" (Singh,S). Abrupt changes in temperature due to changes in weather heats and cools alternately



PHOTOGRAPH NO. 11 : MUD CRACK



PHOTOGRAPH NO. 12 : SOIL EROSION

rock surfaces causing mineral expansion and contraction resulting in breaking off of individual mineral grains of frail rock structure. The molecular break up of rocks whether from physical or chemical cause is termed granular disintegration. The breaking up of onion like layers of rock is termed exfoliation. It is also important to consider that water lying in between the cracks of rocks or between individual mineral grains when frozen expands in volume and gains capacity to break and shatter even the hardest types of rocks. Some weathering processes are chemical. It is often the case that weak solutions of various chemical acids in water enters into the bedrock and attacks the mineral grains present in the rock composition. There are two types of results of such attack; firstly the dissolution of the chemical sub-stances in water and eventually their removal; secondly, production of chemical compounds that acquire more space than the original minerals compelling the weathered rock to swell and disintegrate. Besids the physical and chemical factors causing disintegration there are other factors such as biotic factors as well which include vegetation, animals and above all man.

The loosening or breaking of rocks by the action of heating, freezing, water, wind and unloading together with cooperation of gravitation is termed disintegration by physical or mechanical weathering; The effects of oxidization, carbonation, desilication

and hydration is termed decomposition of rock by chemical weathering, and effects of vegetational biotic and human action is termed Biotic weathering. These physical or mechanical, chemical and biotic weathering processes produce the covering and soil from bedrock. Some of the large, distinctive landformshave come in-to existence by weathering alone. Its most important function, although not easily discernible, is the preparation of mineral matter for the formation of soils and the decay and disintegration of bedrock so that it can be easily transported away by wind, water and streams.

Soils although the products of weathering are not strictly geomorphic phenomenon yet process great geomorphic, geologic and economic significance. Weathering according to its function may be classified under following categories:-

(i) It aids masswasting and erosion

(ii) It is a factor in the general lowering of land surfaces

(iii) It contributes to the evolution of land forms

(iv)It is a major process involved in the formation of regolith and soils.

The different processes of weathering combined together exert in decomposition, fragmentation or weakening of bedrocks at or near the surface of the earth. The portion of the earth's crust, which is affected

by weathering, is called the zone of weathering. The extent of depth, which is affected by weathering, cannot be predicted with certainty. The duration of operation of weathering and the position of water table influence the extent of depth of weathering processes. It is the zone of aeration above the water table where the most active chemical weathering occurs. Oxidation effects are below this level but solution and hydration may extend below it. Erosional agents such as streams with the assistance of gravity carrying rock debris can break, fragment and remove solid bedrock with ease if the same had already been weakened by weathering. Hydraulic action deflation and glacial scouring are most effective on unconsolidated materials but it is certainly not possible to assess the extent to which rock weathering hastens erosion.

Chemical solution may cause a lowering en masse of topographic surfaces in certain areas, which have lime stone, dolomite or gypsum under the earth's surface. Lime stone areas under humid climates usually are lower than adjecent areas of fragmental rocks.

Some of the products of differential weathering are hardly to be classed as land forms but rather are geologic features which add variety to topographic surfaces (Thornbury) weathering pits are generally found on lime stones and looks like potholes caused by wearing away. They are also found in granites and similar rocks. Smith (1941) has described circular or elliptical weathering pits.

Out of all the natural resources available on earth soils are next to water most important for man. Soils produce much of the needed supply of food not only for man but also for animals, insects and birds. ~~It is,~~ therefore, soil is, from economic point of view, the most significant result of rock weathering. Soils of every region reflect its geomorphic history. Satisfactory definitions of soil has not been given so far. Bushnell (1944) however maintained that soil is a natural part of the earth's surface being characterized by layers parallel to the surface resulting from modification of parent materials by physical, chemical and biological processes operating under varying period of time. It is now accepted by all that five major factors which take part in the development of soils are. (1) Climate, (2) topography, (3) parent material (4) Soil biota including both vegetative cover and organisms within and (5) time. At least three of there factors, viz., topography, parent material and time are geological in nature, Climate is although geographical in nature but is influenced to a great extent by topography of the area concerned. Originally soils were classified into two major groups: (a) residual and (b) transported. Residual soils were classified according to the type of rock which originated them, for example sand stone soils, lime stone soils, granite soils etc. The classification of soil as glacial, alluvial, colluvial, eolian was done under transported soil on the basis of which the materials were deposited.

The study region of the lower part of Sasurkhaderi river is a part of the Ganga Yamuna Doab of northern India. The study region is composed of alluvial soil and is a vast plain with a slope from west to south east. Heavy rains during the monsoon and high temperature combined with storms are the causes of weathering as well as removal of the soils. Vegetation, tilling for crops, man's activities concerning establishment of settlements and industries and other biotic factors are responsible for weathering of earth's surface. A perusal of table no 2.3 of the preceding chapter discloses that the entire area under study lies in the level and the gentle slope classes. More than 97 per cent of angle frequencies are concentrated in level slope. Only 3 per cent of the entire study region is in the category of gentle slope and other higher categories are absent.

RAVINATION AND ASSOCIATED PROCESSES

The study of ravine resulting from the processes of erosion is one of the significant aspects of environmental science in general and fluvial geomorphology in particular. Improper land use causes accelerated soil erosion and leads to the formation of gullies and ultimately ravines. When both soil and sub soil are commonly friable and easily cut by flowing water we have gullies with vertical walls. Where the subsoil is resistant to rapid cutting because of its heavy texture or roughness, and especially where the underlying geological material or substratum is not softer than the horizon above, gullies

develop sloping banks and take a "U Shaped" form. This type is commonly found in areas where the soil is under-lain by a stiff clay. Another peculiarity of the gully erosion is that, in case of soils having tough or clay pan sub soil, it expands laterally about as rapidly as in the direction of the head leading to bank erosion. Ordinarily when a gully bed cuts into the soil with an immediate drop of 3 or 4 metres and gradually flattens out, a ravine is formed. The depth of a ravine may extend to 30 meters or more.

The study region has a number of gullies, which are tending towards ravines. The photographs of a few samples of gullies developing into ravine have been exhibited in photograph No. 8

Areas affected by gullies are mostly along the banks of the river, especially in the eastern part. This part of the area consists of deep alluvium soil and erosion has taken place on both sides of the river where the run-off has to negotiate steep slopes. The problem of gullies is very acute in eastern parts of the region which require immediate anti-erosional measures and reclamation.

Areas of agricultural land affected in the interior where the gullies are very small can be reclaimed by check dams combined with growing of grasses or other soil binding plants. Still further up there may be region where the erosion has just set in and the cost of reclamation may be the least in such areas. Here simple measures such as stop closure to grazing and providing oultlets for excessive run off and

controlling soil erosion may be sufficient to reclaim such lands in a period of 2-3 years and bring them under cultivation.

The ravines themselves can be brought under cultivation if they are sufficiently wide by the formation of a series of terraces one below the other. Where they are less wide they can also be terraced and used for growing horticultural crops like grafted mangoes, guavas, etc. depending upon the financial resources of the farmers concerned. While demarcating ravines for plantation of fruit, we should ascertain the available irrigation facilities. A part of such land can be converted into small tanks to meet the irrigation demands.

In general such ravines can bewell used for a forestation wherever possible, so that they may serve as a source of fuel and timber. Land thus reclaimed could also be utilized for settling landless labourers, wherever possible. The control and reclaimation of ravines can be achieved by construction of marginal bunds for diversion channels in the catchment feeding the ravines; by the construction of check dams or gully plugs in the ravines at proper intervals; by toning down or easing the steep slopes of the gully banks to the angle of natural repose and sodding the slopes with grasses having soil binding tendencies; by planting of suitable fast growing trees and shrubs along the bank of the river and in the cut up areas which are unfit for other purposes; by construction of better farming practices and soil conservation measures in the table lands of the catchment.

Chapter VI

IMPACT OF GEOMATERIAL, RELATED PROCESSES AND LAND FORMS ON AGRICULTURE AND LAND USE PATTERN

The choice of utilisation of land for a particular purpose can be decided only after an examination of the soil in the field, its nutrition status, texture, permeability, organic matter content and other characteristics. The result of the examination determines the use, management and treatment of the land.

Lower Sasurkahderi river basin under study, which in corporates parts of six blocks viz. Chail Manjhanpur Muratganj, Kaushambi, Sirathu and Newada in district Kaushambi, is generally fertile except certain areas having usar patches. The land use pattern from the west to the east of the region indicates different soil conditions and different land forms. Unculturable waste lands are located in isolated patches. Sheet and gully erosion on the slopes and banks of drainage channels have rendered some of the areas unfit for cultivation. Some patches have scattered kankars which render them unsuitable for agriculture and they are either left fallow or are heavily grazed. The alluvial tracts to the west are best suited for cultivation of

crops which require a good amount of moisture and most of this area raises two crops i.e. kharif and rabi and some of the areas are used for Jayad crop also. The khadar i.e. lowlying land occupying a level lower than that of the Bangar is covered with sandy loam and is very useful for Rabı cultivation. The cultivation of potato is mainly concentrated in the alluvial tracts. In khadar areas, where the water table is high and the surface moisture ample, the loamy moist or clayey soils are suitable for cultivation of paddy and summer vegetation. But abundance of moisture or water logging adversely affects crop yields in years of heavy rainfall, otherwise such lands produce on an average 10.0 quintals of paddy per acre under present available conditions. Due to lack of irrigation oldest alluvium soils are covered mostly by social forestry and only small patchy clearings amidst them are utilised for agriculture. Deforestation has progressed at an alarming rate in the region under study and much of the area under newer alluvium especially in eastern region has since been brought under cultivation.

The distribution of area under various land uses, viz., cultivated lands, cultivable lands, orchards and forests etc has been presented in Table No. 6.1. The area under study has been classified into nine broad categories, based on the uniform Indian land use classification. The spatial temporal variation of these nine land use categories in the area under study have been analysed and mapped (Fig no.6.1) .Within

TABLE NO. 6.1

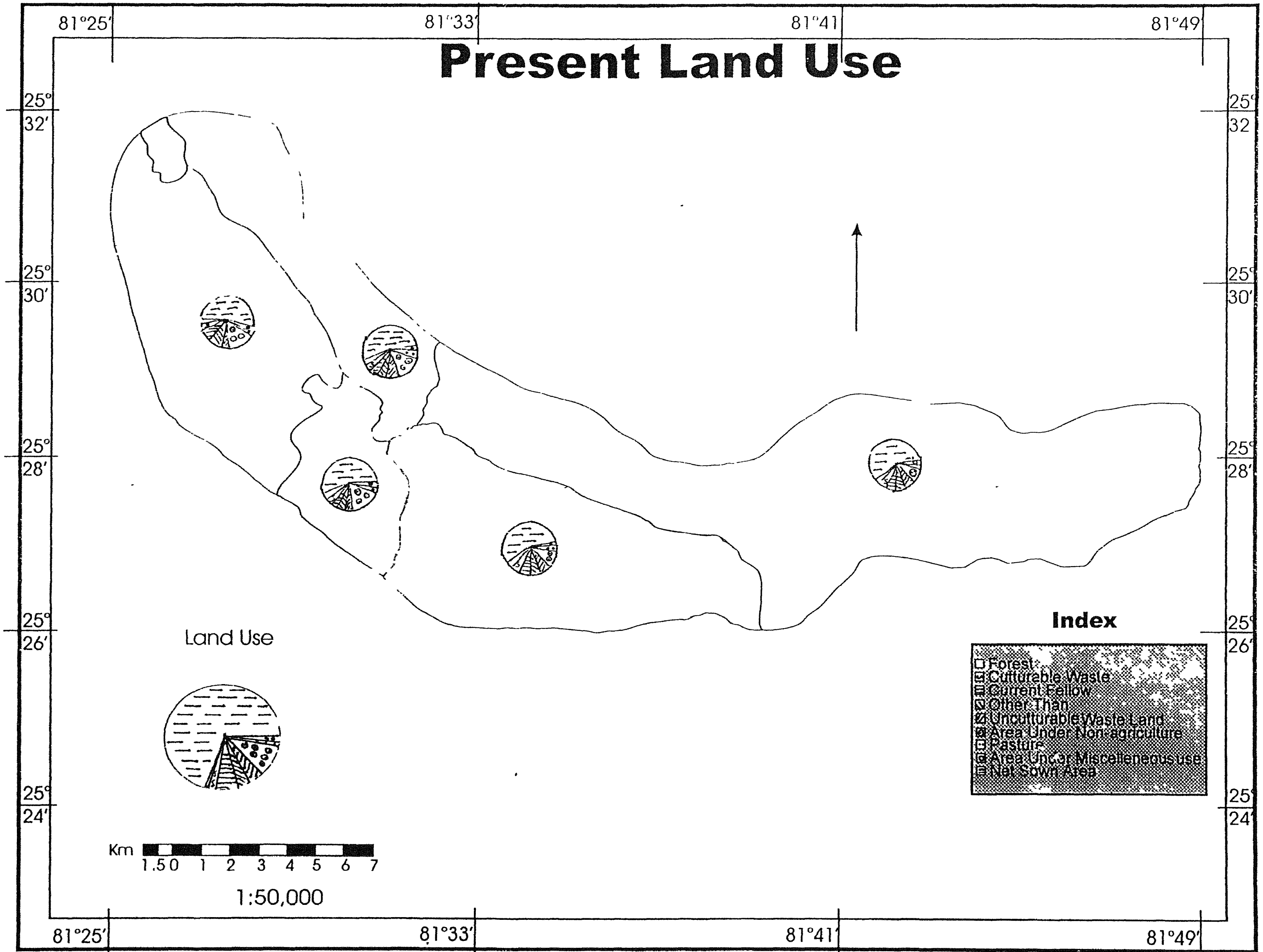
Classification of present land use

Sl No	Particulars of Classification	(Year 1993-94) Area in Hectares	% of the total area	Year 1995-96) Area in Hectares	% of Total area
1	Forest	18 15	0.06	4 00	.01
2	Culturable waste land	803 68	2 67	785 86	2 61
3	Current Fallow land	2,543 45	8 45	2179 98	7 25
4	Other than current fallow land	1,595 30	5 30	1083 60	3 60
5	Unculturable waste land	1,354 50	4.50	1,347 29	4.48
6	Area under non agriculture	2,997 96	9 96	2,999 46	9 96
7	Pasture	67 43	0 22	90 30	0 30
8	Area under Miscellaneous use	505 68	1 68	541 43	1.80
9	Net sown Area	20,213 85	67 16	21,068.08	69 99
	Total	30100	100	30,100	100.00

Source Statistical year book, Statistical department Allahabad

the entire geographical area under study the cultivable area occupies specific importance because table No 6.1 indicates that agriculture is the main occupation of the people and it is the only source of income of about 79 per cent of the population. The table shows that 67.16% and 69.99% of the total area during the years 1993-94 and 1995-96 respectively belonged to net cropped area.

The area of culturable waste land during the years 1993-94 and 1995-96 were 2.67 per cent and 2.61 per cent. Thus there was a slight



Present Land Use
81°25′
81°33′
81°41′
81°49′
25° 32′
25° 30′
25° 28′
25° 26′
25° 24′
Land Use
Index
Forest
Culturable Waste
Current Fellow
Other Than
Unculturable Waste Land
Area Under Non-agriculture
Pasture
Area Under Miscelleneous use
Net Sown Area
Km
1.5 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 6.1

decrease of 0.06% in the culturable waste land. The total fallow lands during these years were 13.75 percent and 10.84 percent. Thus the fallow lands were reduced by 2.91 per cent. The area not available for cultivation amounted to 11.86 and 12.06 per cent in the two years respectively. A scrutiny of the available data regarding utilization of area for raising crops discloses that the cropped area does not remain constant all through. It varies from year to year due to changing natural phenomena, water facilitics and certain other agronomic conditions. There has been a phenomenal increase of 2.84 (70-67.16)% in the net sown area during the year 1995-96 in comparision to the year 1993-94.

It is quite possible and natural also that land put to non agricultural uses may increase in the coming days because of the demand for more land for irrigational channels, roads and other utilities. Since utilization pattern is a dynamic feature; it always changes with the passage of time. Waste lands will be reclaimed every year. The table shows that natural forest is almost negligible. It was only 0.06 per cent during the year 1993-94 and even this negligible area was reduced to .01 per cent in the year 1995-96. But with the help of social forestry the forest area may slightly increase. From the above analysis it is clear that expansion of agricultural land in the region is limited.

TABLE NO.6.2

LAND UTILIZATION (1993-94)

1993-94	Sirathu		Manjhanpur		Kaushambi		Muratganj		Newada		Chayal			
	Area Hect.	%	Area Hect.	%	Area hect.	%	Area hect.	%	Area hect.	%	Area hect	%	Total of The are Under study	%
Forest	0.98	.01	8.83	0.03	8 34	0 02	-	-	-	-	-	-	18.15	0.06
Culturable Waste land	10.69	.035	96 12	0 31	90.78	0 30	80.10	0 24	224 28	0 74	301 71	1 05	803 68	2.67
Current fallow Land	33.80	0 11	304.20	1 01	287.30	0.96	253.50	0.84	709 80	2 36	954385	3 17	2543.45	8.45
Other than current Fallow land	21.20	0.07	190.80	0.63	180.20	0 59	159.00	0.52	445 20	1 47	598.90	1.98	1595 30	5.30
Unculturable Waste land	18 00	0.05	162 00	0.53	153.00	0 50	135.00	0 44	378 00	1 25	508 50	1 68	1354 50	4 50
Area under non Agriculture	39.84	0 13	358 56	1 19	338 64	1 12	298 80	0 99	836 64	2 77	1125 4	3.73	2997 90	9 96
Pasture	0 90	0.00	8 06	0 02	7 62	0 02	6 72	0.02	18 82	0 06	25 31	0 08	67 43	0 22
Area under Miscellaneous use	6.72	0 02	60 48	0 20	57.12	0 18	50.40	0 16	141 12	0 46	189 84	0 63	505 68	1 68
Net sown area	266 40	0.88	2397 60	7 96	2264 40	7 52	1998 00	6 63	5594 40	18 58	7693.0	25.55	20213.8	67.16
	398.53	1 32	3586 65		3387.40		2981 52		8348 2		1397 6		30100 0	100

Table No.- 6.3

Land Utilization (1995-96)

1995-96	Sirathu		Manjhanpur		Kaushambi		Muratganj		Newad		Chayal		Total	
	Area Hect		Area Hect.		Area Hect.		Area Hect.		Area Hect		Area Hect.		Area Hect	
Forest	.40	0.001	3.60	0.012	-	-	-	-	-	-	-	-	4 00	0.013
Culturable Waste land	10.44	0.03	93 99	0 312	88 77	0.305	78.33	0.260	219.31	0.938	295 02	0 980	785.86	2.61
Current fallow Land	26.32	0.087	336.81	1 12	323.65	1 07	197.34	0 65	552.55	1.84	743.31	2.47	2179.9	7.25
Other than current Fallow land	14.40	0.057	129 60	0.430	122 40	0 406	108.00	0 359	302.40	1.005	406.80	0 351	1083.6	
Unculturable Waste land	17.90	0.069	161.14	0.535	152.18	0.505	134 30	0.446	375.98	1.249	505 79	1 680	1347.2	4.48
Area under non Agrculture	39 86	0 132	358 74	1.192	338.81	1.125	298 95	0.993	837 06	2.781	1126.0	3 741	2999.4	
Pasture	1.20	0 003	10.80	0.035	10.20	0.034	9.00	0.029	25.20	0.084	33 90	0 112	90 30	
Area under Miscellaneous use	6 83	0.022	64.80	0.215	61.20	0 203	54.00	0 179	151.20	0.502	203.40	0 676	541.43	
Net sown area	283.32	0.941	2549 88	8.471	2408.22	8.001	224.90	0 747	5949.7	19.766	9652.0	32 066	21068	
		1.33		12.323		11.646		3.670		27.951		43 077	30100.	99.98

The main emphasis therefore, should be on intensification of agriculture on the available agricultural land rather than on the expansion of cultivable area. There is still vast scope to multiply productivity per hectare by use of high yielding varities of seeds, manure and irrigational facilities together with other modern techniques due to pressure of agricultural population on cultivable land. Some increase in the multiple cropped area has been observed.

The Special temporal variations of nine land use categories of the area under study have been analysed and mapped. The aim of this study is to show the block wise emerging pattern of land use in the regions under study.

The Block wise land use pattern of the area under study has been detailed in Table no. 6.2 and 6.3.

LAND UNDER FOREST

The area under forest is extremely low in the region under study. It may not be out of place to mention that forest forms a distinct ecosystem and type of vegetation which is the result of topography, climate and human interference. For maintaining a sound ecological balance, at last 33% of a region must be covered under vegetation. The area under forest in the study region was only 0.06 per cent and .01 per cent during the years 1993-94 and 1995-96 respectively. The distribution of the forest cover in the region is most uneven. Forest

cover is nil in the areas falling in Newada, Muratganj and Chail blocks. Low forest cover is found in the area falling in Manjhanpur block and a bit higher concentration of forest cover is found in Sirathu block. Efforts have been made to increase the vegetation in the area under social forestry scheme executed by the Up-Forest Department. Trees have been planted on both sides of the roads and pataris of irrigation channels under social forestry. The area covered under the scheme was 505.68 Hectares upto 1993-94 which increased to 541.43 Hectares by the end of 1995-96. The forest department launched schemes of afforestation, conservation and plantation of economically useful trees in the open scrub land and old forest area. Due to deforestation the forest had degenerated into open lands covered with scrubs, thorny bushes and dry meadows. Overgrazing and deforestation have reduced the open scrub-by land to barren and unproductive land. Such conditions have mostly happened in the western part of the region. It is, therefore, necessary to develop other plantations in the open scrubby and barren Lands.

CULTURABLE WASTE LAND

Culturable waste land provides an index of the availability of land for areal extension of agriculture. Extension of agriculture through reclamation of waste land is important for developing the

region under study. The rapid growing population callsfor cultivation of waste lands and expansion of agricultural land.

Stamp defined waste land as the land which has been previously used but now abandoned and no further use has been found for such land.

The area under barren and culturable land is low in Kaushambi Block. The medium category is found in Manjhanpur, Claial and Newada blocks. Comparatively high category of barren and culturable waste land is in Muratganj and Sirathu Blocks.

The area under culturable waste land is not signifieant. It was 803.68 Hectares in the year 1993-94 and 785.86 Hectares in the year 1995-96. It terms of percentage of the total area under study it was 2.67% and 2.61% respectively. The slight fall in percentage i.e. .06% indicates that efforts to reclaim the culturable waste land for agricultural use are going on.

With some dynamic efforts towards expansion of irrigation and introduction of modern techniques culturable waste land can be reduced and converted into agricultural land. The proportion of waste land is found to be high where the reliability of rain fall and facility of irrigation is low and the terrain is unfavourable for cultivation. Decrease of culturable waste land has occurred in the areas where the development of irrigation and extention of agricultural reclamation of waste land for cultivation have taken place. Much of the increase in

Non Culturable Land

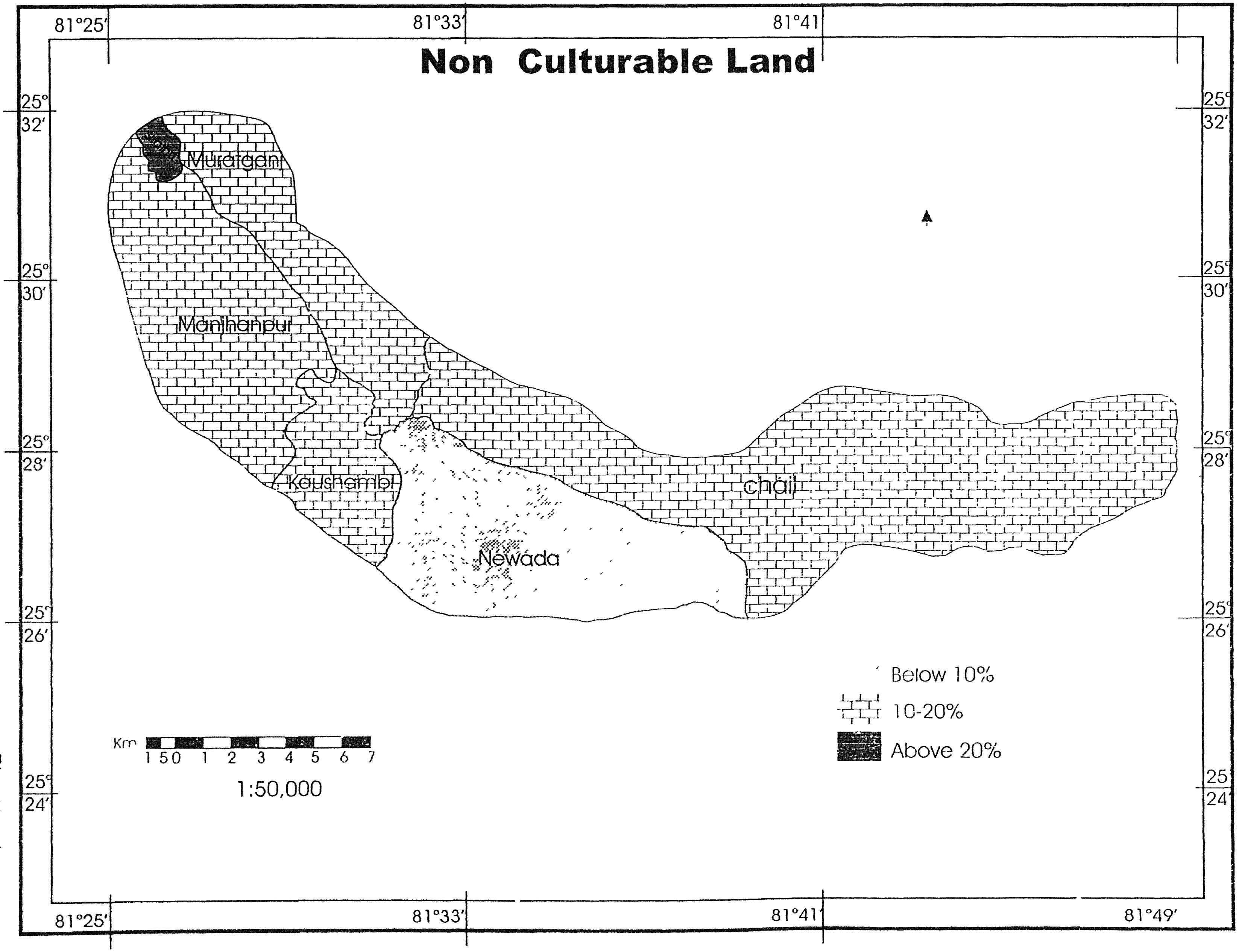


Fig No 6.2

cultivable waste land takes place mostly due to the increase of fallow land when cultivation of agricultural land is uneconomic under unfavourable climatic condition and improper management of land.

CURRENT FALLOW LAND

A perusal of the above table discloses that 8.45 per cent of the total area under study was under current fallow land during the year 1993-94 which was reduced to 7.25 per cent during the year 1995-96. Areas falling in Sirathu, Muratganj and Kaushambi Blocks contain low percentage of area under current fallow. The block wise percentages of Sirathu, Manjhanpur, Kaushambi, Muratganj, Newada and Chayal during 1993-94 were 0.11, 1.01, 0.96, 0.84, 2.36 and 3.17 and during 1995-96 were 0.08, 1.12, 1.08, 0.66, 1.84 and 2.47 respectively.

OTHER THAN CURRENT FALLOW

Follows other than current fallow are factually potentially agricultural land. Current fallow land after one year, if not brought back under cultivation due to slackness or some other problems of the farmers, may turn into waste land. The farming techniques have improved and so have cropping patterns. The current fallow land should not be left uncultivated. Fallows other than current fallow should partly be cultivated directly and partly by reclaiming. The

blockwise areas of fallows other than current fallow in Sirathu, Manjhanpur, Kaushambi, Muratganj. Newada and Chayal were 21.20, 190.80, 180.20, 159.00, 445.20 and 598.90 hectares during 1993-94 and 14.40, 129.60, 122.40, 108.00, 302.40 and 406.80 during the year 1995-96 respectively as shown in Table No. 6.2 and 6.3. The total area of all blocks during the two years were 1595.30 and 1083.60 hectares i.e. 5.30% and 3.60% of the area under study. Thus 1.7% of the fallows more than one year old have been reclaimed. Concentrated efforts are needed to reclaim the remaining old fallow lands with the help of mdern techniques and providing irrigation facilities.

UNCULTURABLE WASTE LAND

A perusal of Table No. 6.2 and 6.3 discloses that the areas of unculturable waste land in all the six blocks viz., Sirathu, Manjhanpur, Kaushambi, Muratganj, Newada and Chayal were 18.00, 162.00, 153.00, 135.00, 378.00, 508.50 hectares during 1993-94 and were 17.90, 161.14, 152.18, 134.30, 375.98 and 505.79 during 1995-96 respectively.(fig. No. 6.2) The total area during the two years calculates to 1354.50 and 1347.29 hectares and 4.50% and 4.48% respectively. Thus there is a very slight fall of .02% during the year 1995-96. The unculturable waste land with the help of modern technique can be converted into useful purposes such as establisment of industries and settlement etc. Barren and waste lands are bad lands

which can be brought under cultivation at a very high cost which is not feasible with _ out government help.

AREA UNDER NON AGRICULTURE

These areas consist of roads, trades and settlement etc. A perusal of the Table No. 6.2 and 6.3 shows that unculturable areas in six blocksviz., Sirathu, Manjhanpur, Kaushambi, Muratganj, Newada and Chayal were 39.84, 358.56, 338.64, 298.80, 836.64 and 1125.48 hectares during 1993-94 and were 39.86, 358.74, 338.81, 298.95, 837.06 and 1126.05 hectares during 1994-95. The areas under non agriculture uses have slightly increased in each block in 1995-96 from those of 1993-94. This increase is due to population prescure which is now a problem of the entire nation.

PASTURES

Permanent pasture or other grazing lands are in_significant constituting only 67.43 and 90.30 hectares during 1993-94 and 1995-96 respectively as shown in Table No. 6.2 AND 6.3 Areas in the six block viz., Sirathu, Manjhanpur, Kaushambi, Muratganj, Newada and Chail were 0.90, 8.06, 7.62, 6.72, 18.82 and 25.31 during 1993-94 and 1.20, 10.80, 10.20, 9.00, 25.20 and 33.90 hectares respectively.

AREA UNDER MISCELLANEOUS USES

The areas under this category consist of parks, recreation and play grounds gardens and other miscellaneous uses. A perusal of Table No.

6.2 and 6.3 discloses that the areas in the six blocks viz., Sirathu, Manjhanpur, Kaushambi, Muratganj, Newada and Chail were 6.72, 60.48, 57.12, 50.40, 141.12 and 189.84 hectares during 1993-94 and 6.83, 64.80, 61.20, 54.00, 151.20 and 203.40 hectares during 1995-96 respectively. The total of all the six blocks were 505.68 and 541.43 hectares which calculates to 1.68% and 1.80% respectively of the area under study.

NET SOWN AREA

The land which are actually cropped during the current agricultural year have been shown as the net sown area in Table No. 6.2 and 6.3 and for the year 1993-94 and 1995-96. The block wise distribution in Sirathu, Manjhanpur, Kaushambi, Muratganj, Newada and Chail blocks were 266.40, 2397.60, 2264.40, 1908.00, 5594.40 and 7693.05 hectares during the year 1993-94 and were 283.32, 2549.88, 408.22, 224.90, 5949.72 and 9652.04 hectares during the year 1995-96 respectively. The total sown area of all the six blocks comes to 20,213.85 and 21068.08 hectares which calculates to 67.16% and 69.99% of the total area under study.

Having presented the overall picture of land use, an attempt has been made here to analyse spatially the various land use categories, Generally, these (aforesaid) nine types of landuse are grouped into three major land use categories for the purpose of examining the

spatial variations in agricultural and non agricultural land. The three categories are-

1. Non Cultivable Land which includes:
   - (i) Unculturable waste land
   - (ii) Pasture
   - (iii) Area under miscellaneous
2. Cultivable Waste and Fallow Land
   - (i) Culturable waste land
   - (ii) Fallow land
   - (iii) Other than current fallow
3. Net sown Area

Table No- 6.4

NON CULTIVABLE LAND 1995-96

Sl No	Category	Percentage of Total area	Frequency of occurrence	Percentage of occurance
1.	High	Above 30	1	16 67
2.	Medium	15-30	1	16.67
3.	Low	Below 15	4	66.66

The spatial distribution of non cultivable land shown in the Table No.6.4 includes four tipes of land viz. (i) unculturable waste land, (ii) area under non agriculture, (iii) Pasture and (iv) area under Miscellaneous use. These areas consist of land under settlements, recreation grounds, industrial units, roads, railways ponds, wells,

irrigation channels and gardens etc. The total area of non culturable lands is 4978.48 hectares which calculate to 16.54 per cent of the region under study. (1) The area of non cultivable land falling in Chail block amounts to 1869.13 Hectares which is 37.54 per cent of total non cultivable land of the area under study amounting to 4978.48 Hectares. (2) The area of non cultivable land falling in Newada block amounts to 1389.44 Hectares which is 27.93 per cent of total non cultivable land. (3) The area of non cultivable land falling in Sirathu, Manjhanpur, Kaushambi and Muratganj blocks amounts to 65.79, 595.48, 562.39 and 496.25 respectively which are 1.32%, 11.96%, 11.29% and 9.96% of total non cultivable area of the study region. Fig no. 6.3.

The category of high non-cultivable land having 16.67 per cent of the total area under non cultivable covers mainly densely populated area and relatively better developed part of the study region. The portion where the river sasurkhaderi meets the river Yamuna is undulating and contains rills and gullies. The second category of medium non cultivable land having 16.67 per cent is covered by settlements and irrigational channels. The third category of low non cultivable land having 66.66 per cent of the non cultivable area is covered under dry and perennial water ponds, roads,parks,gardens and soil erosion etc.

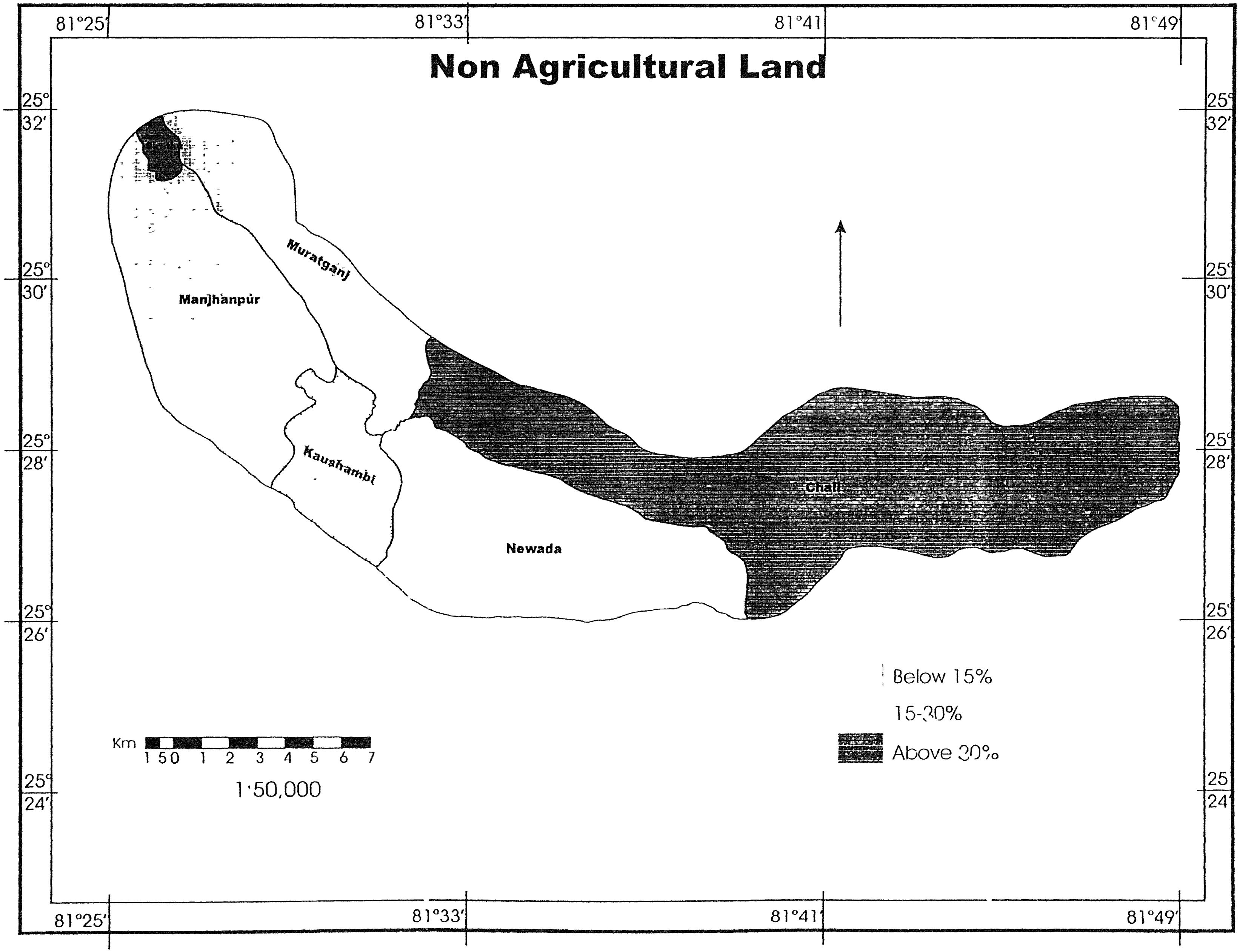

Non Agricultural Land
81°25'
81°33'
81°41
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
Manjhanpur
Muratganj
Kaushambi
Newada
Chail
Below 15%
15-30%
Above 30%
Km
1 5 0 1 2 3 4 5 6 7
1:50,000

Fig No 6.3

Table No. 6.5

CULTIVABLE WASTE AND FALLOW LAND 1995-96

Sl No	Category	Percentage	Frequency of Occurrence	Percentage of occurrence
1	High	above 20	2	33.33
2	Medium	10-20	2	33.33
3.	Low	Below 10	2	33.34

The spatial distribution of cultivable fallow land shown in table no. 6.5 includes three typs of land viz., (i) culturable waste land (ii) current fallow land and (iii) other than crrent fallow land. This category of cultivable fallow land is regarded as potential agricultural land. The concept of waste land is not a new phenomenon. This term 'waste land' has been used to indicate little used common land usually on less fertile soil, which failed to yield a return to the cultivators. Waste land means differently to the layman. The adjective waste has now disappeared because in many cases these common lands are much valued as open spaces. The fallow lands other than current fallow land are considered to be potential agricultural land in the cultivable fallow land group, because this category after one year if the same lands are not brought back under cultivation due to slackness or some problems of the farmers, may turn into waste lands. It is pertinent to mention that forming techniques and cropping pattern are always on the way towards improvement. Hence the lands which are taken to be

Culturable Waste Land

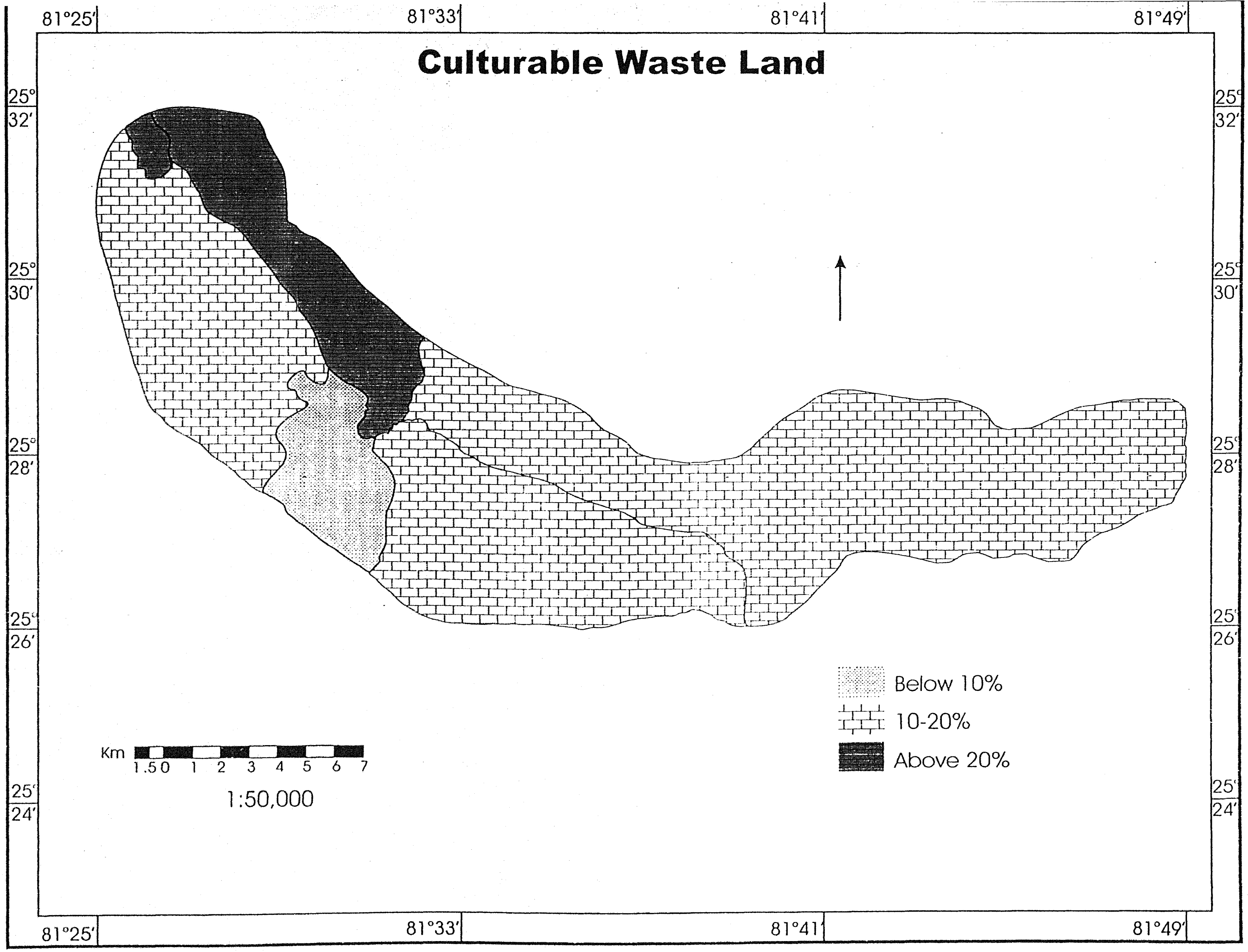


Fig. No. 6.4

barren and uncultivable can partly be cultivated directly and partly by reclaiming.

The total area of cultivable fallow land is 4049.44 hectares which calculates to 13.46 per cent of the region under study.(fig.no. 6.4) The area of cultivable fallow land falling in Newada and Chail blocks amounts to 2529.39 (1074.26+1445.13) hectares which is 62.21% of the area of cultivable fallow land. Such area in Manjhanpur and Kaushambi blocks is 1095.22 (560.40+534.82) hectares which calculate to 27.05%. Such area in Sirathu and Muratganj block is 434.83 (51.16+383.67) hectares which calculate to 10.74 per cent of the cultivable fallow lands.

The spatial distribution of the cultivable fallow land as shown in the table under high, medium and low categories is 33.33, 33.33 and 33.34 respectively which are almost the same.

Table No. 6.6

NET SOWN AREA 1995-96

Sl No	Category	Percentage	Frequency of Occurrence	Percentage of occurrence
1.	High	above 40	1	16.67
2.	Medium	20-40	1	16.67
3.	Low	below 20	4	66.66

The spatial distribution of net sown area has been shown in the above Table No. 6.6. Blockwise sown areas in 6 blocks of Sirathu,

Manjhanpur, Kaushambi, Muratganj, Newada and Chail during the year 1995-96 were 21,068.08 (283.32+2549.88+2408.22+224.90+ 5.949.72, 9.652.04) hectares. The percentage of the net sown areas in each of these blocks calculates to 1.35%, 12.11%, 11.44%, 1.06%, 28.24% and 45.80% respectively during 1995-96. The spatial distribution of the net sown areas as shown in the Table No6.6 under high, Moderate and low categories are 16.67%, 16.67% and 66.66% respectively.fig.no. 6.5

AGRICULTURAL CHARACTERISTICS

The economy of region under study is based on agriculture. Hence agricultural planning is necessary for a planned development of the region. Agricultural planning can not be formulated without proper diagonosis of agricultural features and the deficiencies therein. The cropping pattern and its related aspects are outcome of variegated physical and socio economic factors. It is a dynamic phenomena and is continuously changing due to differences in topography and interference of increasing population and their activities. With this view in mind present chapter has been under taken to analyse the cropping pattern in the lower Sasurkhaderi river basin. The region is self sustained area in which traditional agriculture,based on centuries of experience, is more a way of life. In traditional agricultural region both seasonal and perennial crops play a part with diversification

Agricultural Land

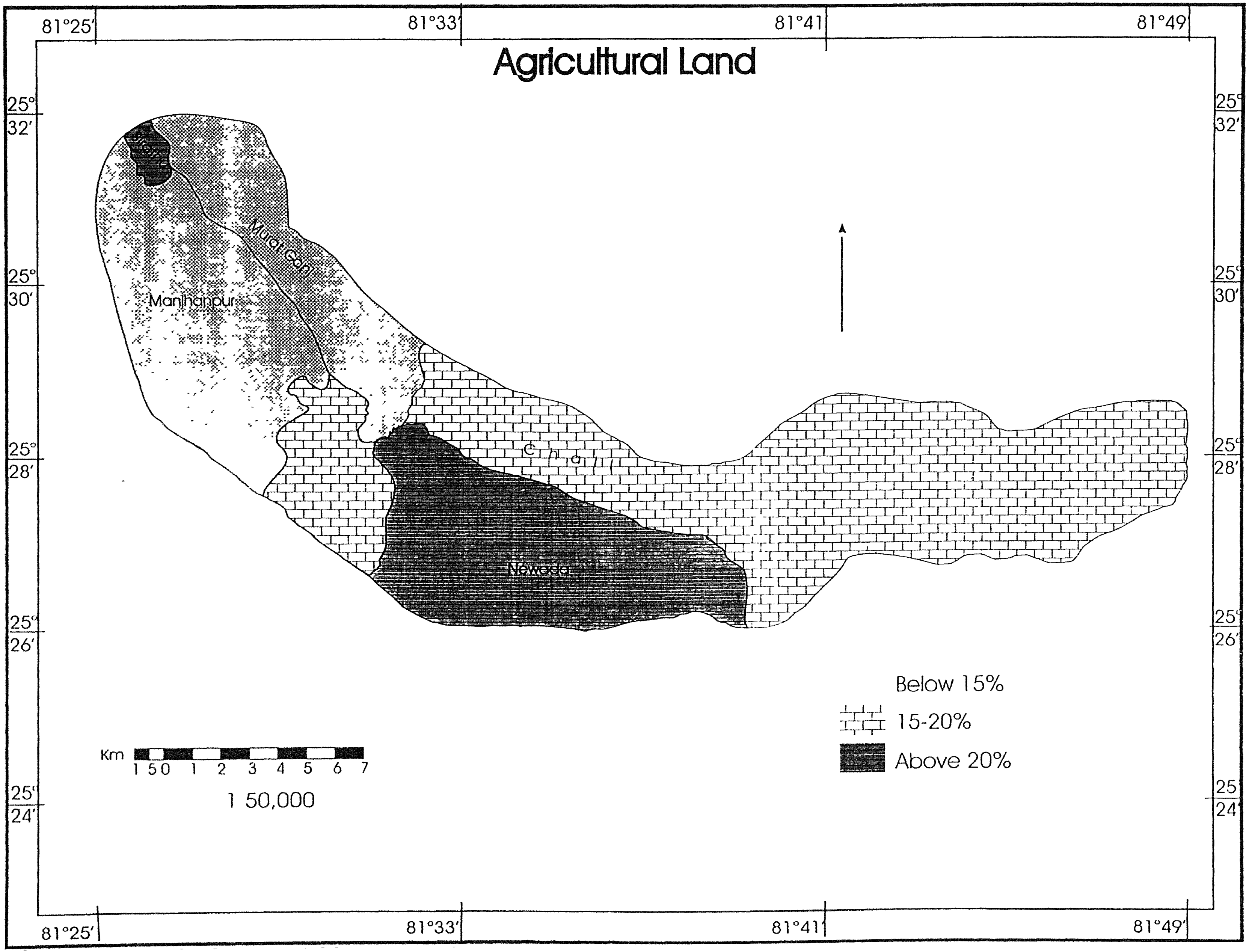


Fig. No 65

emphasized rather than specialization of a limited range of crops. Agricultural change in the region has involved certain limited land use modifications. These modifications represent an expression of equilibrium between the exogenous and endogenous forces influencing farming at different time. The aggregate results of these individual actions are reflected in the changes in the various crops and their interactions in the intensity of cropping, and thereby in the delineation of crop pattern change~~s~~ in the region.

Productivity of land is the function of many inputs such as quality of soil, quality of seeds, fertilizers, human efforts, agricultural implements and irrigation, but it is also a known fact that an assured irrigation is the pre condition for the fuller utilization of the capacities of other inputs applied in cultivation. The efficiency of other inputs can be handicapped by the inadequacy of irrigation, Modern agriculture inputs, such as high yielding varieties of seeds and chemical fertilizers, are more responsive to irrigation. Programme of high yielding varieties of seeds and its success is directly related to an assured water supply. An estimate of the Indian council of Agricultural Research shows that crop production is about 50 to 100 percent higher in irrigated areas in comparison to unirrigated land in the same locality.

IRRIGATION FACILITIES: A general study of irrigation and emerging intensity of irrigation have been attempted here. Main

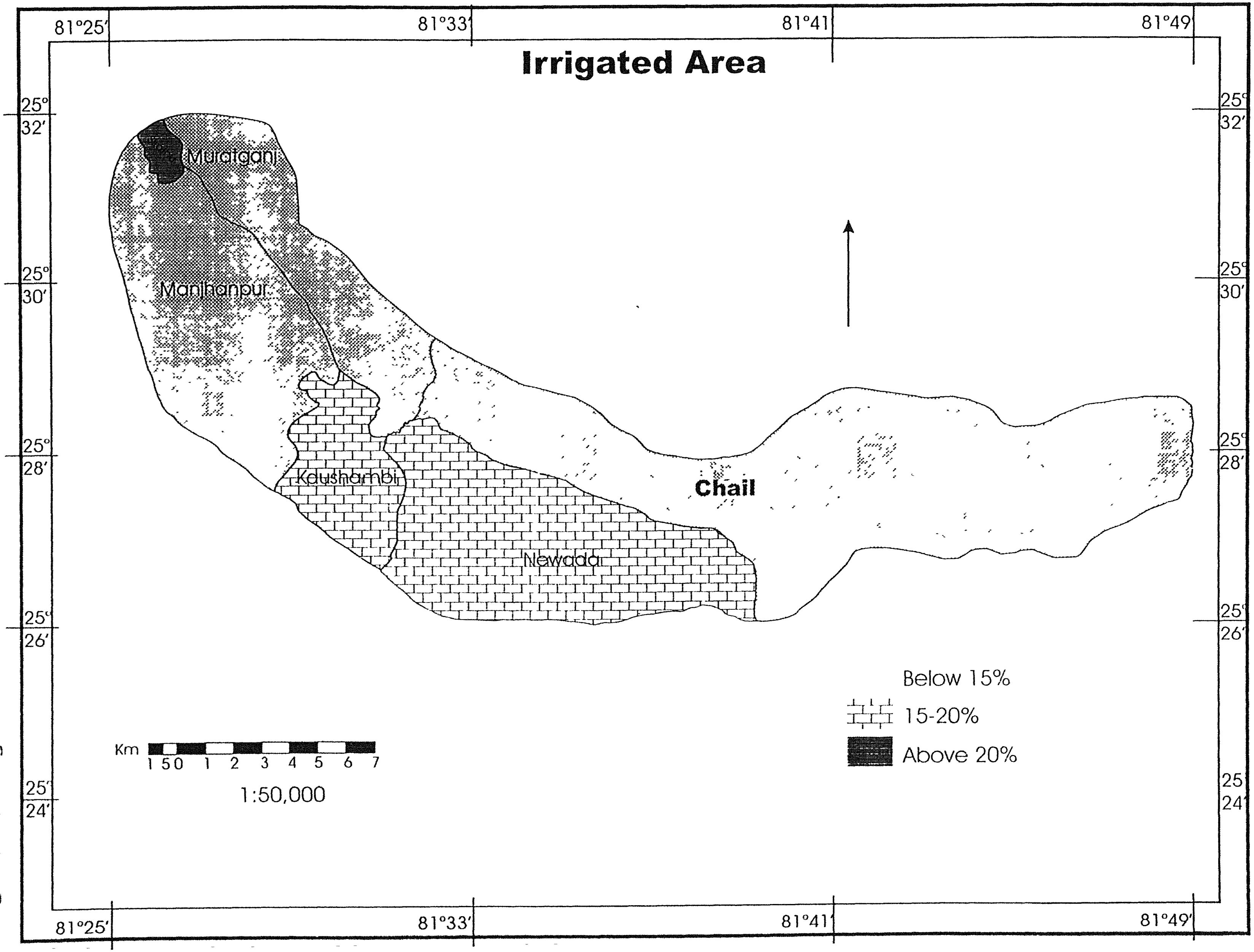

Irrigated Area
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
Muratganj
Manjhanpur
Kaushambi
Newada
Chail
Km
1 5 0 1 2 3 4 5 6 7
1:50,000
Below 15%
15-20%
Above 20%

Fig No. 6 6.B

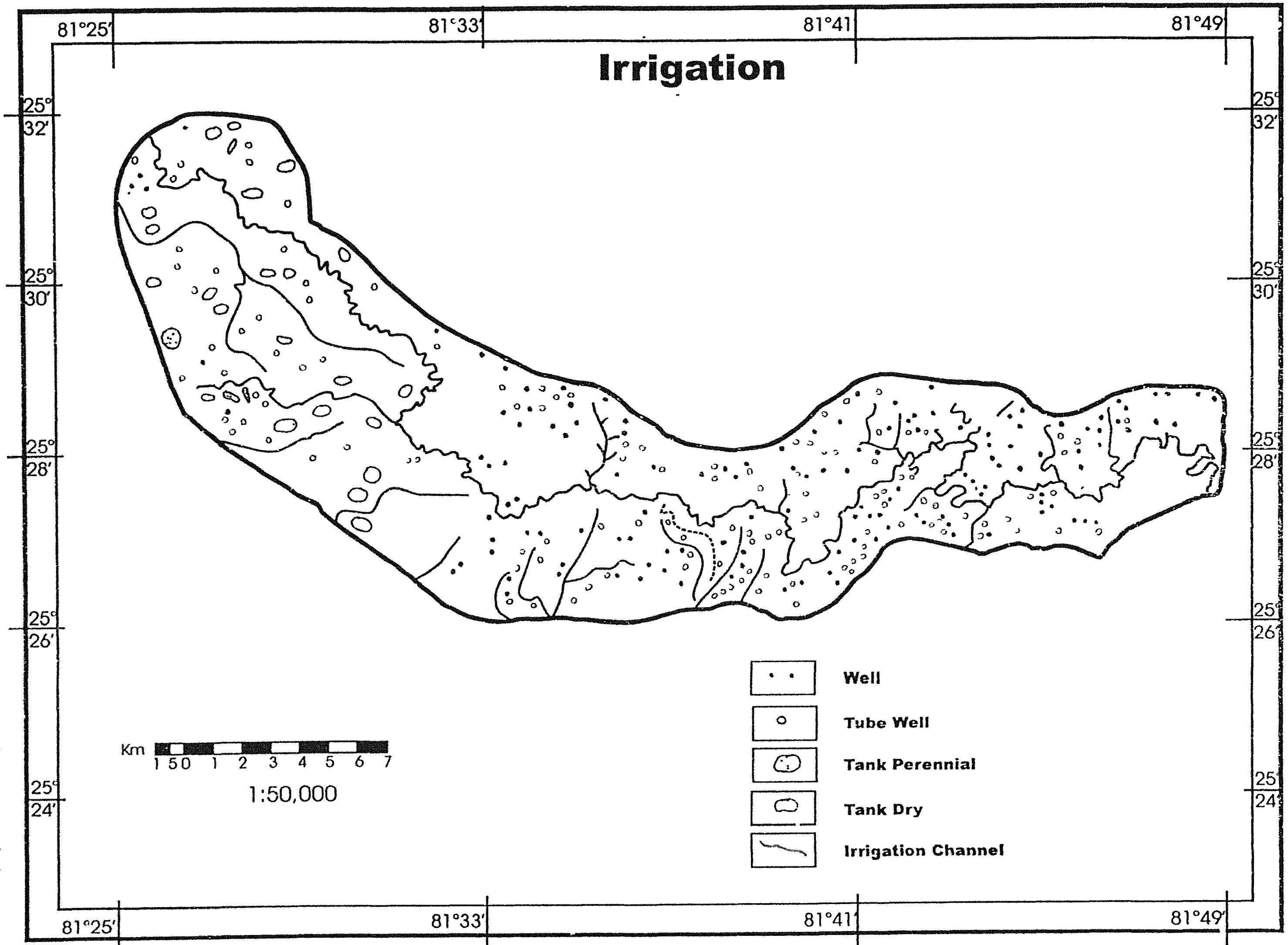

Irrigation
81°25'
81°33'
81°41'
81°49'
25° 32'
25° 30'
25° 28'
25° 26'
25° 24'
Well
Tube Well
Tank Perennial
Tank Dry
Irrigation Channel
Km 1 5 0 1 2 3 4 5 6 7
1:50,000

Fig. No. 66 B

source of irrigation is tubewell, well and irrigation channels as shown in fig. No.6.6B

The river of the study region Sasurkhaderi is a rain fed river and as such it cannot supply water for irrigation throughout the year. Rabi crop is wholly dependent on artificial irrigation.

Canal and pond irrigation is not so important in the region.

The farmers depend mostly on tubewells and wells for irrigating their fields. Block wise area irrigated during 1995-96 through different sources has been shown in the undermentioned table.

Table No. 6.7

AREA IRRIGATED THROUGH DIFFERENT SOURCES (IN HECTARES) IN 1995-96

Blocks	Canal	TubeWell		Well	Tanks	Other	Total land
		Govt	Pri.			sources	under irrig.
Sirathu	20.8	24.4	108 41	50	00031	--	154.13 (1.33%)
Manjhanpur	187 2	219 6	986 69	--	29	--	1393.78 11.96%)
Kaushambi	176 8	207.4	931.88	--	28	--	1316 36(11 29%)
Muratganj	156 0	183 0	816.00	--	--	--	1155.00 (9.97%)
Chail	587 6	689.3	3068.70	14.20	--	--	4359 80(37 54%)
Newada	436 8	512.4	2293 20	10.92	--	1.59	3284.9(27.91%)
Total	1565 20	1856.10	8204 88	25 62	.57	1.59	11653.96

Source : Statistical year book.Statistical Department Allahabad

Canal irrigation in the area under study is done by Manjhanpur distributary, Sachwara minor, Myohar Khas minor, Ibrahimpur minor, Ambari minor, Imligaon minor, Jaitipur minor, Jaraini minor, Telgori minor, Rehi minor and Bareti minor which are the channels of Ram Ganga Canal System and lower Ganga Canal System. These subsystems (distributory and minor) irrigated total area of about 1565.20 hect. In 1995-96. This canal irrigation undoubtly tried to increase progressively the irrigated land of the region.

Table No. 6.7 indicates that tubewells play the most important role of irrigation. 1856 hectares are irrigated by Government Tubewells whereas 8204.88 Hectares are irrigated by private tubewells. On the whole tubewells supply irrigation for 10060.98 (1856+8204.88) hectares out of the total irrigated area of 11653.96 hectares. Thus 86.30% of the irrigation is supplied by Tubewells.

Irrigation from wells is being done in the study region from the earliest times. Though the area irrigated by well is not very significant yet wells play important role in supply of drinking water and irrigation of limited area. The construction and maintenance of wells have been mainly the result of private enterprises. Water is raised from wells by manual labour and through bullocks. One of the disadvantages of irrigation by wells is that the water has no fertilizing property in itself. On the other hand canal water carries large quantities of fertilizing silt to the irrigated fields. It is, therefore,

necessary to use manure on soil irrigated by wells. By well irrigation only 25.62 hect. of land was irrigated during 1995-96.

In this discussion there are two points which need emphasis first, the extention of the area under irrigation, second the best use of the irrigated area through double cropping and high yielding technology. This means that extension of irrigation is not going to be the sole or even the major instrument for agriculture development. An intensive use of whatever land is irrigated would, of course, form a part of the strategy of development. (Bandhopadhyay, 1988) It may be pointed out that the sources and techniques of irrigation should also be improved in terms of efficiency and reliability. Irrigation by means of pump sets and tube wells will be increased and help considerably in improving the agricultural land resources and farm production.

AREA AND PRODUCTION OF CROPS

A perusal of table no. 6.8 discloses that the areas under wheat barley, Arhar,oilseeds, peas and gram during Rabi crops in 1993-94 were 13725, 796.98, 796.33, 349.45, 589.15 and 535.20 hectares and the yields were 270657, 10887, 10, 344, 1992, 5143 and 5143 quintals respectively. Thus the largest area was under wheat and smallest area was under oilseeds.

A prusal of the Table No. 6.9 discloses that the area under Rice, Jwar, Bajra, Maize, pulses (urd Mung) during the kharif fasl in the year 1993-94 in the study region were 10, 115.58, 1508.00, 2771.00,

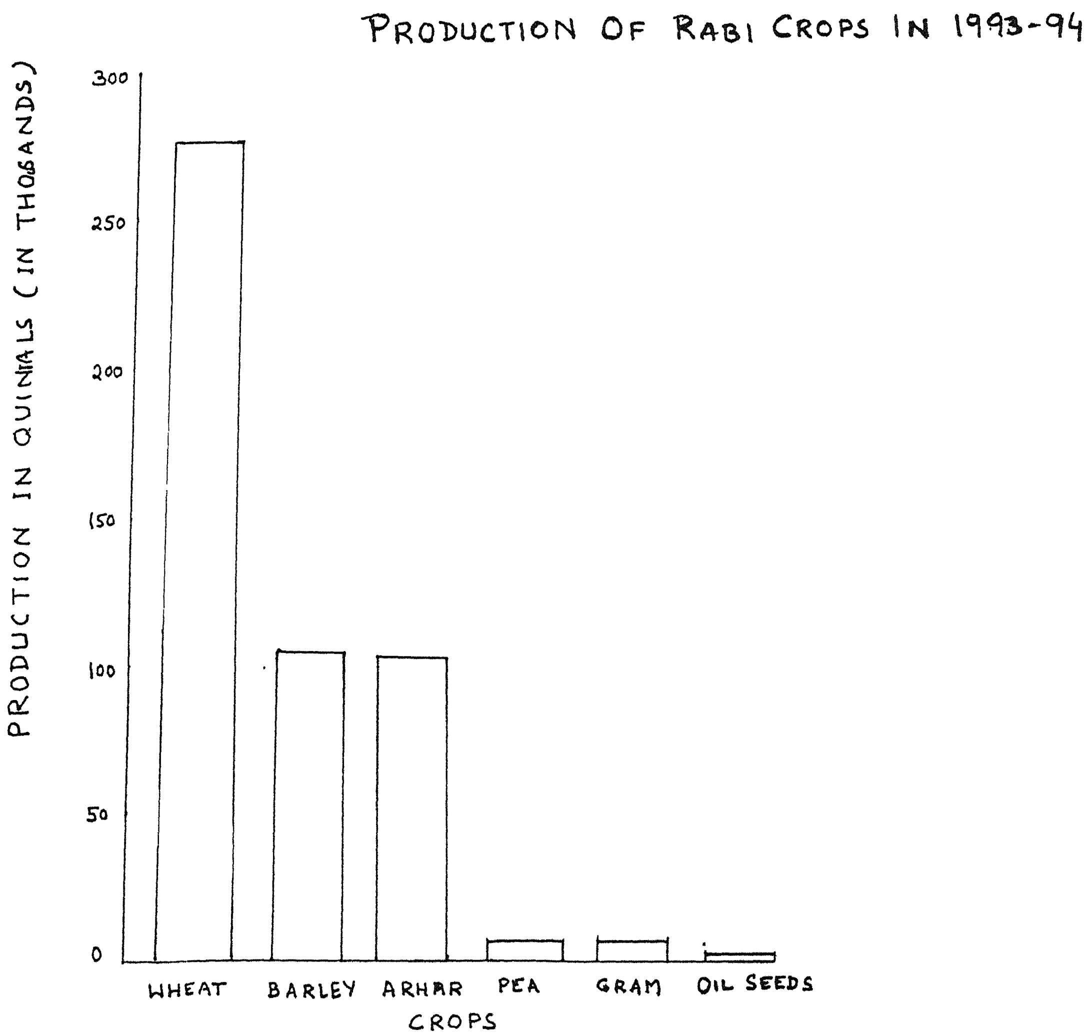

PRODUCTION OF RABI CROPS IN 1993-94
PRODUCTION IN QUINTALS (IN THOUSANDS)
300
250
200
150
100
50
0
WHEAT
BARLEY
ARHAR
PEA
GRAM
OIL SEEDS
CROPS

Fig No. 6.7

Table No. 6.8

Production of Rabi crops in 1993-94

Sl.No.	Crops	Area in Hectares	Productivity Qtl/Hectare	Production in Quintals
1.	Wheat	13725.00	19.72	270657
2.	Barley	796.98	13.66	1088.7
3.	Arhar	796.33	12.99	10344
4.	Oil seeds	349.45	5.70	1992
5.	Pea	589.15	8.73	5,143
6.	Gram	535.20	9 61	5,143

18.39 and 74.06 Hectares and the yields were 173988, 13843, 32227, 217 and 75763 Quintals respectively. The main major Rabi crop of the region under study area (Fig.No.6.7 & 6.8) is depicted by figures.

Table No. 6.9

Production of Kharif Crops

Sl.No	Crops	Area	Productivity Qtl/Hect	Production in quintals
1.	Rice	10115.58	17.20	173988
2.	Jwar	1508.00	9.18	13843
3.	Bajra	2771.00	11.63	32227
4.	Maize	18.39	11.60	217
5.	Pulse (urd+Mung)	74.06	10.23	75763

PRODUCTION OF KHARIF CROPS IN 1993-94

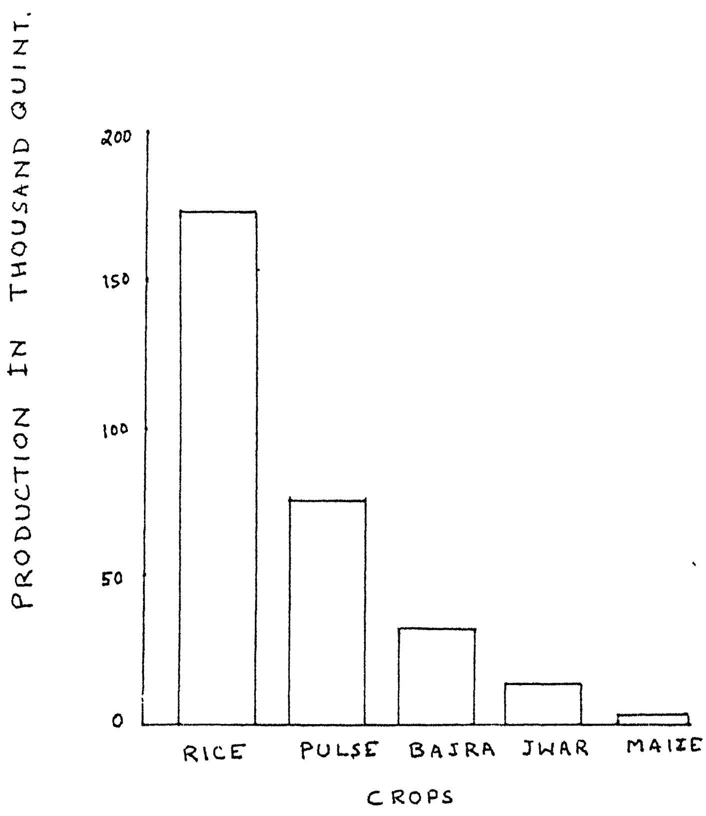


Fig. No. 6.8

Table No 6.8 and 6.9 are based on the data published by Agriculture department

Table No.6.10

PLANT NUTRIENTS REMOVED BY CROPS

Crop	Yield (kg/hectare)	Plant nutrients removed (kg/hectare)		
		Nitrogen	Phosphorus	Potassium
Paddy	2800	37	13	9
Wheat	2240	35	22	11
Jowar	1120	17	10	8
Bajra	896	15	7	10
Maize	2788	47	26	15
Barley	2564	37	21	13
Mustard	692	22	11	28
Linseed	1008	19	12	32
Sugarcane	90317	85	60	190
Potato	17562	85	30	140

GEOMATERIAL AND AGRICULTURE

Soil testing is essential for knowing the fertility status of a region. Soil samples from the lands located in the area under study in the six blocks have been collected and got tested in the laboratory of Agriculture department of Pratapgarh. The result of the soil tests has

been incorporated in the Table No. 4.1 & 4.2.The result of the soil tests has been analysed in detail in the preceding chapter.

Nitrogen, Phosphorus and Potash are all needed by plants in substantial quantities. Each of these must be available to the plant either from the soil it-self or from the addition of manures or chemical fertilizer to the soil

The need of these elements vary from crop to crop. One plant species may be several times as rich in a particular element, such as nitrogen, than another. The higher the yield of a crop, the greater the demand for all the necessary elements. The composition of a crop is subject to variation dependent upon the soil, the variety grown, the climate and other conditions. However, none of these variations is great, compared to the over all needs of the plant. The knowledge of the average composition of a few crop plants is, there fore, useful. The content of the three major nutrients for several crop species, expressed as kilograms per hectare of nitrogen, phosphate and potash in the grain and fodder of crops producing better than average yields, is given in table no. 6.10.

It is not meant to suggest that the crops with the yields shown in the table can be grown on soils which contain only the indicated amounts of these nutrients. Actually larger quantities than those shown in the table are necessary to obtain these yields.

The total stock of nutrients in the soil is large compared to the requirements of a single crop. However, as has already been mentioned, not all of this supply is uniform immediately usable by plants.

GEOMATERIAL AND LAND USE PATTERN

The study region being part of Doab is composed of fluvial soil brought by the rivers Ganga and Yamuna in the vast tract of Northern India. The main problem of the area is that due to deforestation and human and biotic activities the basin has been eroded along the both sides of river bank and rills and gullies have been formed. May of the gullies are tending towards ravine formation. More than 10% of the basin has been converted into unculturable waste land or fallow land. The classification of land use pattern has been shown in the table no. 6.1. However more than 67% of land of the basin is under cultivation but the productivity of the land is low in comparison of other parts of the Doab region.

SUMMARY AND CONCLUSION

The area under study, the lower portion of Sasurkhaderi river basin, lies in the Kaushambi district which before April 1997 formed part of the Allahabad district. The basin has a catchment area of about 30,100 hectares and is located between 25° 26' 40'' and 25° 32' north parallels of latitude and between 80° 25' and 81° 49' east meridians of longitude. The entire study region consists of parts of each of the six blocks, viz., Sirathu, Manjhanpur, Kaushambi, Muratganj, Newada and Chail. The present study has been divided into six chapters concerning with geomorphic processes, associated morphological features relating to soil and its influence of land use pattern and agriculture.

The study region is a part of Ganga Yamuna Doab of northern Indian plain. It has been formed by deposition of fluvial silt brought down by the rivers. Sasurkhaderi river is a tributary of the river Yamuna and is a rain fed river which remains dry except during the rainy season. The climate of the region is sub humid and moderate temperate. The maximum and minimum temperature is recorded 48 °c and 5° c in the month of June and January respectively. The maximum 17° c and minimum 6° c ranges of temperature are in the month of April and August respectively. Average annual rainfall of the region is 975.4 mm but average rainfall variation is very large and some times

results in drought condition. The seasonal variations in the region are well marked & therefore, almost all types of crops are grown in the study region but Rabi crops can not be grown without irrigational facilities provided by wells tube wells and canals. The formation of the study region consists of alluvial deposition of Aryan group raised during quarternary epoch of recent and Pleistocene ages. The composition of alluvia is the fluvial deposit consisting of sand, silt and clay brought down by the river Ganga and Yamuna from Himalayas. The slope of the region is from north west to south east direction and the course of the river is parallel to that of the river Yamuna with in the central depression. This river performs the function of the central drainage system of the doab area. During the summer, this river dries and agriculturally this river is not very important for irrigation. The river has many rills and gullies especially along its bank due to soil erosion. Natural vegetation cover is very important to protect the land from erosion. The area under natural vegetation is extremely low due to the damages caused by human activities such as illegal felling of trees, uncontrolled grazing and branch trimming. Forest cover is nil in the areas falling in Newada, Muratganj and Chail blocks. Due to deforestation the forest had degenerated into open lands covered with scrubs, thorny bushes and dry meadows. Overgrazing and deforestation have reduced the open scrub by land to barren and unproductive land. The region is covered by fertile alluvial deposits

which can be classified into two types (i) Older alluvium and (ii) New Alluvium on the basis of properties of textures of the soil samples. The soil of the study region can be classified into three broad categories viz. (i) Sandy loam to Loam (ii) Sandy Clay Loam (iii) Clay Loam to Clay.

Taken as a whole the basin has a wide expanse of gently undulating ground. The absolute relief of the region may be classified into two broad categories of low (0-100 metres) and high (above 100 metres). The lower category is found in about 68 percent of the total regional area whereas the areal distribution of high category is found in 32 percent of the total area. The areal extent of low absolute relief, of more than about 68 percent clearly speaks of the flattish and plain topography of the study region. The monotony of the flattish character of the alluvial plain is broken by the gullies and eroded bank sites. The analysis of relief aspects of the region indicates that relative relief is less than 6 metres in the maximum areas. Relative relief is 9 to 12 metres in some patches of the area. Higher relative relief in the eastern part of basin is in only two patches. It indicates that the most of the region is level and at few places, areas of gullies and undulating tracts are found. Frequency of average slope in each category and its percentage of total frequency of the basin indicate that more than 97 percent of angle frequencies are concentrated in level slope. Only about 3 percent of the total area of the study region is in the category

of gentle slope. Other higher categories are absent in the study region. Frequency distribution of dissection index of extremely low categories is represented by more than 99 percent of the total frequencies; only 1 percent of the total frequencies are distributed in low category. In this low category of dissection index 87.04 percent of the frequencies come under the first extremely low category (0-.05) of dissection index and 11.06 percent of frequencies come under second category (.05-.10) of dissection index. This shows that more than 99 percent of the total area of the study region is very lowly dissected.

There is no definite pattern in the distribution of dissection index in the study region. Higher magnitude of dissection index has been observed in the only three patches of the study area instead of a continuous zone.

The analysis of drainage aspects of the region indicates that more than 83 percent frequencies are concentrated in the very low and low categories. About 8 percent of the total frequencies are found in moderate category and only 7.64 percent of the total frequencies are found in high categories. Frequency of very high category of drainage density is totally absent in the study region. This shows that on an averages, this area is a region of low drainage density.

In drainage texture, about 45 percent of the frequencies are distributed in the fine drainage texture category (very fine and fine). Whereas about 5 percent of frequencies are distributed in the

moderate drainage texture and the remaining 50 percent of the frequencies are concentrated in coarse and very coarse drainage texture categories.

Entire study region is characterized by very poor to poor categories of stream frequency. More than 83 percent of the total surface area of the entire study region is under very poor category of stream frequency. About 10 percent of the area is under transitional category (very poor to poor). Only 5.13 percent of the area is under poor category of stream frequency. The over all distribution of stream frequency, throws light on the landscape in terms of both topographical and lithological characteristics of this basin which is a part of Doab. The high proportion of level area is the most important factor where gullying has resulted due to formation of numerous rills.

The correlation analysis of geomorphic variables and their influencing factors have been explained in the subsequent paragraphs. The relative relief is positively correlated with average slope which is weak ($r = 0.15$) but its correlation with dissection index is ($r = 0.99$) which is considerably high.

The coefficients of correlation between slope and drainage density, and between slope and stream frequency are $r = 0.17$ and $r = 0.14$ respectively. This result points out that low drainage density is found in the area of level slope. It means that slope and drainage density are positively related.

Similarly a positive correlation of r = 0.04 between slope and drainage texture falls in the same situation. It has also been observed in the study region that gentler the slope the coarser is the drainage texture, resulting in the lesser number of streamsper unit length. The relationship between slope and stream frequency is also weak (r = 0.14).

It is essential to mention here, as has been discussed earlier, that slope is not solely responsible for controlling these morphometric attributes, but also the association of favourable rainfall, vegetation, lithological and geological structure have their own share in affecting the drainage density, stream frequency and drainage texture.

The study of hydrology of the region showsthat the whole of the region receives a mean rainfall of 97.5 cm. Agriculture is mainly carried on with the help of irrigation from wells.

It is essential to examine the physical and chemical properties of soil to know the fertility of soil of a region. The knowledge of the physical properties of the soil is essential for the purpose of characterizing the soil and more particularly in respect of determination of suitability for agriculture in the area under study. Texture is of primary importance to know the ability of soil to resist water and wind erosion. The distribution of sand content in soil shows that low sandy area is concentrated in 3.7 percent of the total occurances. The medium sandy area is 7.4 percent of total occurances

and the high sandy area is concentrated in 88.9 percent of the total occurances. Low category of silt content is found only in 11.1 percent of the total occurances. About 81.5% part of the total region have medium silt content and the high category is found in only 7.4 percent of the total occurances. The presence of clay in soil makes it sticky when wet and hard when dry; such soil is heavy clayey & has the capacity of holding plant nutrients. Generally the amount of clay varies from 25 percent to 30 percent within the area under study. The distinguishing features of such type of soils in a particular area are based on the nature of surface morphology and the hydrological character. Thus the texture colour and reaction of the soil are the result of the action and reaction of these factors.

The knowledge of the chemical properties of the soil is also important for the purpose of characterizing the soil. The quantity of organic matter present in the area is low. The distribution of nitrogen in the area under study shows that the percentage of nitrogen is not high. The phosphate content of the major part of the region is extremely low. PH of the soil determines acidic or basic nature of the soil. The soils of the region have shown PH value of more than 7 indicating that they are alkaline in their character. Salinity of the soil is determined by electric conductivity (E.C.) Salinity means the predominance of chlorides and sulphate of sodium and magnesium in the soils. The presence of the salt in the soils affects the growth of

various plants. Cultivation is not possible on saline soil unless they are flushed out with large quantities of irrigation water. The soils of the total region are non-saline (salinity effects most negligible) and the general growth of the plant is not adversely affected. The factor that influences soil formation are parent material, relief, climate and biosphere. The parent material of these soils is primarily alluvium, deposited by river Ganga and Yamuna, transported from the central Himalyas, which has sedimentary rock e.g., shale schists, limestone, sand stone, quartzites and phyllites etc. The alluvium is composed of in varying proportion of sand, silt and clay particles. These alluvia deposits belong primarily to Pleistocene and secondarily to holocene period of the quaternary era. Composition of the sediments in the profile are sandy loam to Loam, sandy clay loam, clay loam to clay. Physiographically most of the study area lies on oldest flood plain of the river Ganga and Yamuna and alluviam is primarily homogenous hence have minor contribution on the genesis of these soils. The soil identified in the area have been differentiated according to their variability in pedogenic process as correlated with the variability in relief. The region under study does not show variety of soils, but a wide range of variation in the physical chemical and biological properties are well marked as already discussed. Soils brought down by rivers covered the major parts of this region which are of two types; older alluvium (Bhanger). New alluvium called khader. On the

basis of properties of textures of the soil samples the soils of the study region can be classified into three broad categories. (1) Sandy loam to Loam (2) Sandy Clay Loam (3) Clay Loam to Clay.

There is continuous process of movement of soil from one place to another due to natural forces. Water and wind are the active agents of soil erosion in the study region the former agency plays the main role than the latter. Water erosion may conveniently be classified into:

(1) Sheet erosion

(2) Rill erosion and

(3) Gully erosion

Places having soil of high silt content, fragile sandy soil, stiff clay and deficiency in organic matter are more susceptible to sheet washing in the study region. Rill erosion is mostly common in regions of intense precipitation and lands of absorptive capacity. The photograph no.12 exhibits the rill erosion in the area under study. Usually gullies follow sheet erosion or they result from the neglect of rills. Lands formed by alluvial soil are susceptible to gully formation and in such condition gullies tend to develop vertical walls which result from undermining and collapse of banks. The photographs no. 3, 5, 6, 7, 8, 9 and 10 have been taken as samples of gullies from different areas under study. Special methods are required to control the growth of gullies, which have developed to considerable size. The

gullied areas can be reclaimed for agricultural and other land uses. The lower basin of Sasurkhaderi river is a part of the famous Ganga Yamuna doab in the Kaushambi district. It has undergone different stages of its development. It has almost plain surface except the erosional topography particularly at the end where this river meets and loses its identity in the river Yamuna.

Attempt has been made to present the study and interpretation of fluvial processes, mechanisms of silt transportation, erosion and deposition; geometric properties and profile analysis of the river channel; riverine environment and associated morphological features; weathering processes; and ravination and associated processes.

The choice of utilization of land for a particular purpose can be decided only after an examination of the soil in the field, its nutrition status, texture, permeability, organic matter content and other characteristics. The result of the examination determines the use, management and treatment of the land. Lower Sasurkhaderi river basin under study, which incorporates parts of six blocks viz. Chail, Manjhanpur, Muratganj, Kaushambi, Sirathu and Newada in district Kaushambi, is generally fertile except certain areas having usar patches. The land use pattern from the west to the east of the region indicates different soil conditions and different land forms. Sheet and gully erosion on the slopes and banks of drainage channels have rendered some of the areas unfit.Scattered kankars which renders them

unsuitable for agriculture and they are either left fallow or are heavily grazed. The alluvial tracts to the west are best suited for cultivation of crops which require a good amount of moisture and most of this area raises two crops i.e. Kharif and Rabi and some of the areas are used for Jayad crop also. Detailed discussion of the physico-pedogenic and agricultural characteristics and their relationship has been done. There is a wide variation in the spatial as well as block wise development. These variations are attributale to physical and environ-mental condition in some areas, while in some others, it is due to lack of soil fertility and irrigation facility. Such problems are found through out the region.

SUGGESTIONS

With the ever increasing population pressure in the country, India is compelled to increase her food supply for which steps must be taken to reclaim the waste and fallow lands and to increase the present low fertility of soils. If the farmers are to become more prosperous, if they are to have more money to raise their standard of living, soil fertily must be increased so that each acre of their land produces more. Fortunately this is possible and by such means it will bring increased income to them and benefit the country as a whole.

The achievoment of green revolution in the country since the nineteen seventies India is now self relient to provide food to her present population but keeping in view the likely increase in the

population and also the existence of more that 30% of the population below the poverty level,who are not getting even two square meals every day, there is still need and scope for much to be done. Given the proper conditions, yield per unit of soils can be multiplied manifold. In addition to the use of improved seeds, measures against attack from pests and diseases, stimulation of farmers incentive, the major areas of soil management are:

(i) Increased supply of water for irrigation

(ii) Adequate supply to soil of organic matter, including green manuring

(iii) Adoption of a suitable plan of crop rotation

(iv) Application of fertilizers

(v) Drain.age and bunding to avoid water logging

(vi) Addition of amendments to saline alkali and acid soils.

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APPENDIX

Hindi	Name	Botanical Names
B	Babul	Acacia arebica
B	Beri	Zygiphys xyloprus
B	Beri	Zygiphys mauritiana
B	Bel	Aegle marmelos
K	Kalisiras	Albizzia libbeck
D	Dhak	Dhao Albizzia pendula
S	Semal	Dombax malabaricum
H	Hingota	Balanite aegyptiaca
K	Karonda	Carrisa carandes
A	Amarbel	Cussuta reflexa
S	Shisham	Dalpergia amus strictus
T	Tendu	Diospyros montena
A	Ambla	Emblica officiaalis
P	Pipal	Ficus religiosa
P	Pakar	Ficus lacor
C	Chaprar	Grewia Flavescens
B	Baheda	Terminalie belerica
I	Imli	Tamarindus indica

APPENDIX NO. 2

VARIABLE NAME: RR N = 301

SAMPLE STD. DEV. = 1.8035157

COEFFICIENT OF VARIATION = 61.409301563%

SUM = 884
SUM OF SQUARES = 3572

DEVIATION SS = 975.8006645

VARIABLE NAKE: AS N = 301

SAMPLE STD. DEV. = .501040234

SAMPLE VARIANCE = .251041316

COEFFICIENT OF VARIATION = 354.604068404%

SUM = 42.53

SUM OF SQUARES = 81.3217

DEVIATION SS = 75.3123947

VARIABLE NAME: DI N = 301

SAMPLE STD. = .017940038

SAMPLE VARIANCE = .000321845

COEFFICIENT OF VARIATION = 61.223938997%

SUM = 8.82

SUM OF SQUARES = .355

DEVIATION SS = .0965535

VARIABLE NAME: DDN = 301

SAMPLE STD. DEV. =2.165724797

SAMPLE VARIANCE = 4.690363898

COEFFICIENT OF VARIATION = 130.559415986%

SUM = 499.3

SUM OF SQUARES = 2235.35

DEVIATION SS = 1407.1091694

VARIABLE NAME: DT N = 301

SAMPLE STD. DEV. = 1.524431559

SAMPLE VARIANCE = 2.323891577

COEFFICIENT OF VARIATION = 145.820669002%

SUM = 314.67

SUM OF SQUARES = 1026.1283

DEVIATION SS = 697.1674731

VARIABLE NAME: SF N = 301

SAMPLE STD. DEV. = 1.970794512

SAMPLE VARIANCE = 3.884031008

COEFFICIENT OF VARIATION = 132.412756262%

SUM = 448

SUM OF SQUARES = 1832

DEVIATION SS = 1165.2093023